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DIFFERENTIATION OF CATTLE AND CARABAO MEAT BY BIOCHEMICAL METHODS, I

DIFFERENTIATION OF UNREFRIGERATED AND FROZEN MEAT

By RAMON A. ACEVEDO and TEODULO TOPACIO
Of the Veterinary Research Division, Bureau of Animal Industry, Manila

TWO PLATES

A previous paper by one of the authors(1) found only limited application, due to the fact that the carcasses of all kinds of food animals slaughtered in the city abattoir are not subjected to refrigeration between the time they are dressed in the afternoon and the next morning when the meat is sold in the city markets; nor is the meat kept under refrigeration during the market hours the next day. Under such circumstances fermentation proceeds more rapidly under Philippine climatic conditions than in colder climates, and blood cells are hæmolyzed or rendered insusceptible to agglutination. Because of this fact attention was turned to developing a process of differentiation by biochemical methods.

The flesh of carabaos is generally of a much darker red than that of cattle. In view of this observation the hæmoglobin contents of the watery extract of these animals were studied, with the intention of making them the basis of differentiation; but hæmoglobin content was found variable in both cattle and carabaos. The sulfur contents of the extracts of the meat of these animals were also found too variable to be of any value in the differentiation. An attempt was then made to determine the cholesterol content. A rough method for extracting cholesterol by treating finely ground meat with ether gave results showing that cholesterol is present in the tissue of the two animals, but the amount was again found variable as determined by the acetic anhydride-sulfuric acid test. However, in connection with the study of the cholesterol content it was observed that the ether extract of the meat of cattle was decidedly yellow, while the ether extract of carabao meat was colorless or in some instances had a very faint tinge of yellow. Coronel,(2) who studied the fat of these two animals, found the same yellow color in the ether extract of cattle fat, and no, or in some instances a very faint tinge of, yellow color in the ether extract of carabao fat.

Upon further investigation the appearance of yellow pigment in ether extracts of the tissue of cattle, and the failure to produce this pigment in the case of carabaos, seemed to be constant. On the basis of the assertion of Rogers,(5) citing the findings of Palmer and Eckles that carotene is present in the blood of the cow as an adsorption complex with serum albumin, it was suspected that the yellow pigment was carotene. This suspicion was verified when the yellow residue of cattle meat ether extract gave a positive reaction to the test for carotene described by Rogers,(5) the antimony trichloride ($SbCl_3$) test. A similar positive reaction was observed when the colorless residue of carabao meat extract was tested. Carotene is present in the meat of these two animals, but in the carabao it seems to occur in a different form. No literature is available on the utilization of the difference in the nature of the carotene occurring in the tissue of cattle and carabaos as the basis of differentiation. The object of the present work is to elaborate a qualitative test based on the difference in the nature of carotene occurring in cattle and carabao tissues.

PRELIMINARY EXPERIMENTAL INVESTIGATIONS

EXPERIMENT 1. DETERMINATION OF THE PRESENCE OF CAROTENE IN CATTLE AND CARABAO TISSUE

In view of observations made during preliminary studies on the cholesterol content of cattle and carabao flesh, and on the findings of Coronel(2) in his study of the fat of these two animals, a study to determine the presence of carotene in the lean flesh of cattle and carabaos was undertaken.

Method.—A practical method for the extraction of carotene from cattle and carabao tissue was evolved from the statement of Rogers(5) that carotene in association with protein can be readily isolated, that it easily disperses in water, and that the solution, like the dry form, does not give up its carotene to fat solvents unless first treated with alcohol. The method consists of the treatment of the ground meat with absolute alcohol for 30 minutes, followed by 30 minutes of extraction with ether, regarded as one of the good solvents of carotene. For the determination of whether the ether extracts obtained by this method contain carotene, they are evaporated and the residues tested with antimony trichloride solution.

Materials.—Ten samples of cattle and 10 of carabao meat were secured from the Azcarraga abattoir soon after the carcasses were dressed.

Apparatus.—The apparatus used were a Universal meat grinder, the smallest size (No. 00) so that even a small piece of meat can be ground through, a small Troemner balance (0.1 to 8 g capacity), an electric water bath with concentric rings to accommodate different sizes of evaporating dishes, 30 cc capacity white glass wide-mouthed bottles, small glass funnels, filter paper, 25 cc capacity Coors porcelain evaporating dishes, a 10 cc graduate, corks to fit the bottles, and tin foils.

Reagents.—Reagents used were Merk's absolute alcohol, Squibb's anæsthesia ether, dry chloroform (Mallinkrodt chloroform, C. P.) dried by addition of a few crystals of calcium chloride, a 28 per cent solution of antimony trichloride in chloroform, and 0.02 per cent aqueous solution of $K_2Cr_2O_7$ as color standard.

Procedure.—All visible fats are removed from the meat sample, and the sample ground through the meat grinder three times. Five grams of the finely ground meat is weighed into a bottle, 10 cc of absolute alcohol added, and the bottle covered with cork wrapped in tin foil. The alcohol is allowed to act, with frequent shaking, for 30 minutes. The alcohol is then decanted and 10 cc of ether added to the meat sample. Ether extraction is carried on for 30 minutes with frequent shaking. The ether extract is then filtered through Schleicher and Schull analytical filter paper No. 589, the filtrate caught in a Coors porcelain evaporating dish, and the intensity of its yellow coloration recorded by ocular comparison with an equal amount of a color standard consisting of 0.02 per cent aqueous solution of potassium dichromate in a Coors porcelain evaporating dish of the same size. The filtrate is evaporated to dryness in the steaming waterbath, and the color of the residue recorded. The residue is then tested for carotene according to the method cited by Rogers(5) by dissolution in 1 cc dry chloroform, and the solution poured in a test tube to which 2 cc of the $SbCl_3$ solution is added. Upon addition of $SbCl_3$ solution a color reaction develops which ranges from pinkish violet to dark blue.

Results.—Each of the 10 cattle and the 10 carabao samples was treated in the manner described above, and it was found that the filtrates of the 10 cattle meat samples were colored yellow in varying intensity, with the exception of 1 which gave a very faint yellow filtrate. When evaporated, all gave an orange-yellow residue of varying amount. On the other hand, the filtrates of the 10 carabao samples were found colorless, with the exception of 2, which gave a very faint yellow tinge, and when evaporated, 8 gave a colorless residue and 2 a light greenish-yellow residue which was markedly different from the residue obtained from cattle filtrates. The residues of both cattle and carabao filtrates gave positive reaction with antimony trichloride. The results are summarized in Table 1.

TABLE 1.—*Color intensity of filtrate, color of residue, and results of $SbCl_3$ test, in cattle and carabao meat samples, where 4+ = 0.02 per cent $K_2Cr_2O_7$ or more; 3+ = about 0.015 per cent $K_2Cr_2O_7$; 2+ = about 0.01 per cent $K_2Cr_2O_7$; 1+ = about 0.005 per cent $K_2Cr_2O_7$; ± = very faint yellow; — = colorless.*

Sample.	Cattle.			Carabao.		
	Color intensity of filtrate.	Color of residue.	$SbCl_3$ test.	Color intensity of filtrate.	Color of residue.	$SbCl_3$ test.
1	2+	Orange yellow.	Violet	—	None	Violet.
2	3+	do	Dark blue	—	do	Dark blue
3	2+	do	Violet	—	do	Violet.
4	4+	do	Dark blue	—	do	Blue
5	3+	do	do	±	Light greenish yellow.	Violet.
6	3+	do	Blue	—	None	Violet.
7	2+	do	Violet	±	Light greenish yellow.	Blue.
8	±	do	Pinkish violet	—	None	Violet.
9	2+	do	Violet	—	do	Pinkish violet.
10	1+	do	Pinkish violet	—	do	Do.

EXPERIMENT 2. DETERMINATION OF THE PRESENCE OF CAROTENE IN CATTLE AND CARABAO TISSUE BY JOHNSON'S METHOD

According to Rogers(5) the color reaction of carotenoids with strong acids or chlorides of polyvalent elements, not excluding the antimony trichloride tests, is not specific for carotenoids but is also given by all substances with polyene structure. Hence, to determine whether the positive reactions with antimony trichloride of the cattle and carabao residues, described in the preceding experiment, were not due to substances of polyene structure other than carotenoid, six samples of cattle meat and six samples of carabao meat were tested for carotene by Johnson's method.

Principle.—Johnson's method as described by Kolmer and Boerner(3) consists in the dehydration of serum with plaster of paris and the moistening of the ensuing powdery mass with absolute alcohol to make a thick paste. The paste is then thoroughly shaken with petroleum ether of low boiling point. The yellow coloration of the petroleum ether indicates carotene, because the extraction of pigment from alcohol-moistened serum is equivalent to extracting a pigmented substance from 80 to 90 per cent alcohol, which indicates that the substance is carotene.

Materials.—Six cattle meat and six carabao meat samples were secured from the Azcarraga abattoir soon after the carcasses were dressed. These samples were kept in a refrigerator until the next morning, when they were used in this experiment.

Apparatus.—The apparatus used were a small meat grinder (Universal No. 00), a small mortar and pestle, a small apatula, a Troemner balance, an electric water bath with concentric rings to accommodate different sizes of dishes or flasks, test tubes, small funnels, Coors porcelain evaporating dishes, corks, and tin foil.

Reagents.—Plaster of paris, Merck's petroleum ether (C. P., 30° to 70° C.), Merck's absolute alcohol, dry chloroform, and a 28 per cent antimony trichloride solution in chloroform were used.

Procedure.—For this experiment the meat sample was prepared for use in the same manner as in the preceding experiment. One gram is weighed and placed in a mortar. It is then triturated and dehydrated with about 3 grams of plaster of paris. The powdery mass is moistened with absolute alcohol into a thick paste and placed in a test tube with a spatula. Three cc of petroleum ether is then added to the paste and shaken thoroughly. The petroleum ether layer is allowed to separate, filtered through filter paper, and the filtrate caught in a Coors porcelain evaporating dish, where it is evaporated to dryness over a steaming water bath. The residues of every two samples of the same kind are dissolved in 1 cc of dry chloroform and tested with 2 cc of 28 per cent $SbCl_3$ solution in chloroform.

Results.—The six cattle meat and the six carabao meat samples were treated in the manner described above. Four of the cattle meat samples produced distinct yellow coloration of the petroleum ether and 2 very slight coloration only, while none of the carabao samples produced any discernible coloration. However, when the filtrates of the cattle and carabao meat samples were evaporated, both the cattle and the carabao filtrates gave yellow fatty residues. The residues from cattle filtrates were of a deeper yellow color than those of the carabao filtrates, and both gave a positive carotene reaction of more or less equal strength with $SbCl_3$ solution.

DIFFERENTIATION OF CATTLE AND CARABAO MEAT BY BIOCHEMICAL METHODS

From the two preliminary experiments two methods of differentiation of cattle and carabao meat by biochemical process were developed. The first method is based on the difference in the color of the residue of the filtrate of ether extract of the meat samples described in the preliminary experiment. The second method is a short cut of the first method.

FIRST METHOD (EVAPORATION METHOD)

Principle.—The principle utilized in this method is practically the same as that described in the first preliminary experiment, with some rather important changes in the reagents used and in the procedure. These alterations make necessary a description of this method in detail.

Materials.—One hundred eleven cattle samples from 111 different animals were obtained as soon as the carcasses were dressed. An equal number of carabao samples were secured in the same manner. The samples were kept in a cool room instead of in an ice box or refrigerator, so that they would be in a condition similar to that of the meat sold in the city markets. Some samples were intentionally exposed further at room temperature to putrefy, and then tested.

Apparatus.—The apparatus, glasswares, and other accessories used were the same as those enumerated in preliminary experiment 1.

Reagents.—Merck's absolute alcohol, Squibb's anæsthesia ether or a mixture of 2 volumes of Squibb's ether and 1 volume of benzine of low boiling point, were used.

Procedure.—The sample is prepared in the same manner as in the preceding experiments. Five grams of the finely ground meat is weighed and placed in a 30 cc wide-mouthed bottle, 10 cc of absolute alcohol added, and the bottle covered with a cork wrapped in tin foil. The alcohol is allowed to act, with frequent shaking, from 5 to 30 minutes. The time allowed for alcohol treatment can be varied, but should not be less than 5 minutes; the longer the time the better the results. The alcohol is decanted and 10 cc of ether alone or 10 cc of the ether-benzine mixture added. Extraction by the fat solvent is carried on from 5 to 30 minutes with frequent shaking. While the extraction is going on, the color of the supernatant is watched. Extraction with ether-benzine mixture gives practically the same results as extraction with pure ether, except that the former gives a clearer supernatant than that obtained with the latter, which is rather turbid and clouds the presumptive reading of results. The longer the action of ether or ether-benzine mixture is carried past 5 minutes the better the result. The extract is then filtered through a Schleicher and Schull paper into a small Coors porcelain evaporation dish. The filtrate is evaporated over a steaming electric water bath, and with the aid of a pair of dish tongs the dish is rotated slightly so that the oily pigmented substance which forms as the ether evaporates does not adhere on the sides of the dish. It will be observed that as soon as most of the ether is evaporated with the watery alcohol portion of the filtrate remaining, the pigmented substances separate out as oily globules, which in the case of cattle filtrates are orange-yellow, and in the case of the carabao filtrates colorless or light greenish yellow. In the dry state these pigmented oily globules present the physical characteristics of butter fats.

Reading and recording of results.—Presumptive reading: As soon as the ether or ether-benzine extraction is finished, the color of the supernatant is determined; if it is yellow, a presumptive identification is entertained that the sample is cattle meat, if colorless, that the sample is carabao meat. The presumptive reading is checked when the extract is filtered into a Coors porcelain dish, where the coloration can be noted more distinctly.

Final reading: The quantity and color of the residue are noted and recorded as follows:

++++, abundant, orange-yellow.
+++, slightly less abundant, orange-yellow.
++, moderate amount, orange-yellow.

+, few clumps, orange-yellow.
±, two or more minute clumps, orange-yellow.
—, practically colorless.

The test of one sample is completed in about 30 minutes.

Results.—Out of the 111 cattle samples tested, 110 gave orange-yellow residues in varying amounts, and 1, which was a badly putrefied sample, gave negative results. Of the 111 carabao samples none gave orange-yellow residues, 99 gave practically colorless residues, and 12 gave light greenish-yellow residues. These results are tabulated in Table 2. (Plate 1.)

TABLE 2.—*Results of tests on 111 cattle and 111 carabao samples by the evaporation method.*

[Legend: yyyy, Very markedly yellow; yyy, markedly yellow; yy, yellow; y, pale yellow; ±y, faint yellow; ?y, barely visible yellow; —, colorless. ++++, Abundant, orange-yellow; +++, less abundant, orange-yellow; ++, moderate amount of orange-yellow; +, few small clumps of orange yellow; ±, two or more minute clumps of orange-yellow; —, practically colorless.]

Sample.	Cattle.			Carabao.		
	Condition.	Ether or ether-benzine filtrate.	Residue.	Condition.	Ether or ether-benzine filtrate.	Residue.
1	Good	yy	++	Good	—	—
2	do	yyy	+++	do	—	—
3	do	yy	++	do	—	—
4	do	yyyy	++++	do	—	—
5	do	yyy	+++	do	?y	Pale greenish yellow.
6	do	yyy	+++	do	—	—
7	do	yy	++	do	?y	Pale greenish yellow.
8	do	±y	±	do	—	—
9	do	yy	++	do	—	—
10	do	y	+	do	—	—
11	Souring	yy	++	Souring	?y	Pale greenish yellow.
12	do	y	+	do	—	—
13	do	y	+	do	—	—
14	do	yyyy	++++	do	—	—
15	do	y	+	do	—	—
16	do	yyyy	++++	do	—	—
17	do	yyyy	++++	do	—	—
18	do	yy	++	do	?y	Pale greenish yellow.
19	do	yyy	+++	do	—	—
20	do	y	+	do	—	—
21	do	yyyy	++++	do	—	—
22	do	y	+	do	—	—
23	do	yyyy	++++	do	—	—
24	do	y	+	do	—	—
25	do	y	+	do	—	—
26	do	yy	++	do	—	—
27	do	yyy	++++	do	—	—
28	do	yy	++	do	—	—

TABLE 2.—*Results of tests on 111 cattle, etc.*—Continued.

[Legend: yyyy, Very markedly yellow; yyy, markedly yellow; yy, yellow; y, pale yellow; ±y, faint yellow; ?y, barely visible yellow; —, colorless. + + + +, Abundant, orange-yellow; + + +, less abundant, orange-yellow; + +, moderate amount of orange-yellow; +, few small clumps of orange yellow; ±, two or more minute clumps of orange-yellow; —, practically colorless.]

Sample.	Cattle.			Carabao.		
	Condition.	Ether or ether-benzine filtrate.	Residue.	Condition.	Ether or ether-benzine filtrate.	Residue.
29	Souring	yyyy	+ + + +	Souring	?y	Pale greenish yellow.
30	do	yyy	+ + +	do	—	—
31	Good	yyyy	+ + + +	Good	—	—
32	do	y	+ +	do	—	—
33	do	yyyy	+ + + +	do	—	Pale greenish yellow.
34	do	yyy	+ + + +	do	—	—
35	do	yy	+ +	do	—	—
36	do	yyyy	+ + + +	do	—	—
37	do	yyy	+ + +	do	—	—
38	do	yyyy	+ + + +	do	—	—
39	do	yyyy	+ + +	do	—	—
40	do	yy	+	do	—	—
41	do	yyy	+ + + +	do	—	—
42	do	y	+ +	do	—	—
43	Beginning to putrefy.	yyy	+ + +	Fair	—	—
44	do	yyyy	+ + + +	Beginning to putrefy.	—	—
45	do	yyyy	+ + + +	do	—	—
46	Fair	y	+ +	Good	—	—
47	do	yyyy	+ + + +	Souring	±	—
48	do	y	+	do	—	—
49	do	y	+	Fair	—	—
50	do	yy	+ +	do	—	—
51	do	y	+	Good	?y	Pale greenish yellow.
52	Good	yyyy	+ + + +	do	—	—
53	do	yy	+ +	do	—	—
54	do	yyyy	+ + + +	do	—	—
55	do	yyy	+ + + +	do	—	—
56	do	yyyy	+ + + +	do	—	Pale greenish yellow.
57	do	yyyy	+ + + +	do	—	—
58	do	yyy	+ + + +	do	?y	Pale greenish yellow.
59	do	yyyy	+ + + +	do	—	—
60	do	y	+	do	—	—
61	do	yyyy	+ + + +	Putrefying	—	—
62	Putrefying	yyyy	+ + + +	do	±	—
63	do	yyyy	+ + + +	do	—	—
64	do	yyyy	+ + + +	do	—	—
65	do	yyy	+ + + +	do	—	—
66	do	y	+	do	—	—
67	do	yyyy	+ + + +	do	—	—
68	do	yyy	+ + + +	do	—	—

TABLE 2.—*Results of tests on 111 cattle, etc.*—Continued.

[Legend: yyyy, Very markedly yellow; yyy, markedly yellow; yy, yellow; y, pale yellow; ±y, faint yellow; ?y, barely visible yellow; —, colorless. ++++, Abundant, orange-yellow; +++, less abundant, orange-yellow; ++, moderate amount of orange-yellow; +, few small clumps of orange yellow; ±, two or more minute clumps of orange-yellow; —, practically colorless.]

Sample.	Cattle.			Carabao.		
	Condition.	Ether or ether-benzine filtrate.	Residue.	Condition.	Ether or ether-benzine filtrate.	Residue.
69	Putrefying	y	+	Putrefying	—	—
70	do	y	±	do	—	—
71	do	—	—	Fair	—	—
72	Frozen	yyyy	+++	do	—	—
73	do	yyyy	++++	do	—	—
74	do	yyyy	+++	do	?y	Pale greenish yellow.
75	do	yyy	++++	do	—	—
76	do	yyyy	++	do	—	—
77	do	yyy	++++	do	—	—
78	do	yyyy	++++	do	—	—
79	do	yyy	+++	do	—	—
80	do	yyyy	+++	do	—	—
81	do	yyy	++++	do	—	—
82	Beginning to putrefy.	yyyy	++++	do	—	—
83	do	y	+	do	—	—
84	do	yyyy	++++	do	—	—
85	do	yyyy	+++	do	—	—
86	do	yyyy	+++	do	—	—
87	do	yyyy	++++	do	—	—
88	do	yyyy	+++	do	—	—
89	do	yy	++	do	—	—
90	do	yyyy	++++	do	—	—
91	do	yyy	++++	Beginning to putrefy.	—	—
92	Fair	yyyy	++++	Fair	—	—
93	do	yyyy	++++	do	—	—
94	do	yyyy	++++	do	—	—
95	do	yy	+++	do	—	—
96	do	yyy	+++	do	—	—
97	do	yyyy	++++	do	—	—
98	do	yyy	++++	do	—	—
99	do	yy	+++	do	—	—
100	do	yyyy	++++	do	—	—
101	do	yyyy	++++	do	?y	Pale greenish yellow.
102	do	yyyy	++++	do	—	—
103	do	yyyy	+++	do	—	—
104	do	yyy	+++	do	—	—
105	do	yyyy	++++	do	—	—
106	do	yyyy	++++	do	—	—
107	do	yyy	++++	do	—	—
108	do	yyyy	+++	do	—	—
109	do	yyyy	++++	do	—	—
110	do	yyyy	+++	do	—	—
111	do	yyyy	++++	do	—	—

SECOND METHOD (DIRECT READING)

Principle.—This method is a short cut of the evaporation method. For reasons given above, the ground sample is first treated with absolute alcohol. After the alcohol treatment, and without decanting the alcohol, a mixed fat solvent is added. The solvent used is a mixture of anhydrous ethyl ether and benzine, or petroleum ether of low boiling point. According to Rogers(6) ethyl ether is a fairly good solvent of carotenes, but petroleum ether is a better solvent of alpha carotene. It was therefore expected that a mixture of these two will result in an efficient solvent of the pigment. By trial it was found that a mixture of anhydrous ethyl ether distilled over sodium gave better results than a mixture of Squibb's anæsthesia ether and petroleum ether. The absolute alcohol is reduced to about 75 per cent alcohol by adsorption of moisture from the tissues. With the addition of ethyl ether-petroleum ether mixture, the ethyl ether portion mixes with the alcohol, and the reduced strength of the alcohol allows the petroleum ether to separate as a layer on the top, carrying with it the pigment extracted by the resulting ethyl ether-alcohol mixture. The coloration of the petroleum ether layer at the top is the basis of differentiation by this method.

Materials.—Sixty-five cattle meat samples from 65 different carcasses and 63 carabao meat samples from 63 carcasses were obtained. The samples were kept at room temperature until the next morning, when they were subjected to the test. This procedure was followed to simulate the condition of meat sold in the city markets.

Apparatus, glassware, and other accessories.—The apparatus used were the same as those used in preliminary experiment 1.

Reagent.—Merck's absolute alcohol, a mixture of equal volumes of Baker's anhydrous ethyl ether distilled over sodium and Merck's purified petroleum ether, C. P., 35° C., and color standards consisting of aqueous solutions of $K_2Cr_2O_7$ of different strengths from 0.005 per cent to 0.04 per cent were used.

Procedure.—As in the preceding experiments, all the visible fats are removed from the sample and the sample put through the meat grinder three times. Five grams of meat is weighed into a 30 cc wide-mouthed bottle and 10 cc of alcohol added. A cork wrapped in tin foil is fitted to the bottle and the alcohol-meat mixture is shaken for 5 minutes. Then, without decanting the alcohol, 8 cc of the anhydrous ethyl-ether petroleum-ether mixture is added and shaken from 1 to 3 minutes. In the case of the cattle meat sample, after the first or second minute of shaking the coloration of the petroleum ether will become apparent. In the case of the carabao meat sample no coloration will be produced; if any color appears at all it is so faint that it can barely be distinguished (Plate 2).

Reading and recording of results.—After the first minute of shaking on the addition of the ether-benzine mixture, the benzine is allowed to separate and examined for yellow coloration by ocular examination. If no coloration is obtained, shaking is resumed for another minute, and the benzine is again allowed to separate on the top and examined for coloration. Three minutes is the maximum time of shaking. The intensity of coloration of the benzine is compared with color standards consisting of aqueous solution of $K_2Cr_2O_7$ as used by Willstater-Stoll(4) in the estimation of carotene in butter fat. The solutions of $K_2Cr_2O_7$ used as color standards are 0.04 per cent, 0.03 per cent, 0.02 per cent, 0.01 per cent, and 0.005 per cent, and the readings on the color of the benzine layer are recorded as follows:

INTENSITY $K_2Cr_2O_7$

++++, ranging from 0.03 per cent to 0.04 per cent.
+++, ranging from 0.02 per cent to 0.03 per cent.
++, ranging from 0.01 per cent to 0.02 per cent.
+, ranging from 0.005 per cent to 0.01 per cent.
±, below 0.005 per cent.
?, very faint, barely visible.
—, no coloration.

To identify the sample producing coloration lower than 0.005 per cent $K_2Cr_2O_7$, its benzine layer together with the small amount of the alcohol-ethyl-ether layer is pipetted out, placed into a small Coors porcelain evaporating dish, and evaported over the steaming water bath. If the meat is cattle meat, the resulting residue will be orange-yellow; if it is carabao meat, the residue is light greenish yellow. The same reaction was observed in the first (evaporation) method. The test of one sample is completed in about 10 minutes.

Results.—Of the 65 cattle samples, 16 gave ++++ reactions, 26 +++, 17 ++, 5 +, and 1 ± which still was plainly more intense than any coloration thus far produced by carabao samples, and when evaporated the benzine layer gave orange-yellow residues. Of the 63 carabao samples 59 gave negative reactions, and 4 produced very slight colorations of the benzine layer, and when evaporated gave light greenish-yellow residues. The results are tabulated in Table 3.

TABLE 3.—*Results of testing 65 cattle and 66 carabao samples by the direct method.*

[Legend: + + + +, color intensity ranging from 0.03 per cent to 0.04 per cent $K_2Cr_2O_7$; + + +, color intensity ranging from 0.02 per cent to 0.03 per cent $K_2Cr_2O_7$; + +, color intensity ranging from 0.01 per cent to 0.02 per cent $K_2Cr_2O_7$; +, color intensity ranging from 0.005 per cent to 0.01 per cent $K_2Cr_2O_7$; ±, color intensity below 0.005 per cent $K_2Cr_2O_7$; ?, color very faint, hardly visible; —, colorless.]

Sample	Cattle.		Carabao.	
	Condition.	Coloration of benzine layer.	Condition.	Coloration of benzine layer.
1	Good	+ + + +	Good	—
2	do	+ + + +	do	—
3	Fair	+ + + +	Fair	?
4	do	+ + +	do	—
5	do	+ + +	do	—
6	do	+ + + +	do	?
7	do	+ + + +	do	—
8	do	+ + + +	do	—
9	Frozen	+ + +	Good	—
10	do	+ + + +	do	—
11	do	+ + +	do	—
12	do	+ + + +	do	—
13	do	+ + + +	do	—
14	Good	+ + +	do	—
15	do	+ + +	do	—
16	do	+ +	do	—
17	do	+ + +	do	—
18	do	+ +	do	—
19	do	+ + +	do	—
20	do	+ + +	do	—
21	do	+ + + +	do	—
22	do	+ + +	do	—
23	do	+ + +	do	—
24	do	+ +	do	—
25	do	+ +	do	—
26	do	+	do	—
27	do	+ +	do	?
28	Fair	+ + +	do	—
29	do	+ + +	do	—
30	do	+ +	Fair	—
31	do	+ + + +	do	—
32	do	+ + +	do	—
33	do	+ + + +	do	—
34	do	+ + +	do	—
35	do	+ +	do	—
36	do	+ +	do	?
37	do	+ +	Beginning to putrefy	—
38	Souring	+ +	do	—
39	do	+ +	do	—

TABLE 3.—*Results of testing 65 cattle and 66 carabao samples by the direct method*—Continued.

[Legend: + + + +, Color intensity ranging from 0.08 per cent to 0.04 per cent $K_2Cr_2O_7$; + + +, color intensity ranging from 0.02 per cent to 0.03 per cent $K_2Cr_2O_7$; + +, color intensity ranging from 0.01 per cent to 0.02 per cent $K_2Cr_2O_7$; +, color intensity ranging from 0.005 per cent to 0.01 per cent $K_2Cr_2O_7$; ±, color intensity below 0.005 per cent $K_2Cr_2O_7$; ∓, color very faint, hardly visible; —, colorless.]

Sample.	Cattle.		Carabao.	
	Condition.	Coloration of benzine layer.	Condition.	Coloration of benzine layer.
40	Souring	++++	Beginning to putrefy	—
41	do	+++	do	—
42	do	+++	do	—
43	do	++++	do	—
44	do	++++	do	—
45	do	+	do	—
46	do	+++	do	—
47	do	+++	Souring	—
48	do	++++	do	—
49	do	+	do	—
50	do	+++	do	—
51	do	++	do	—
52	do	++	do	—
53	do	+++	do	—
54	do	++	do	—
55	do	+++	do	—
56	do	++	do	—
57	do	+++	do	—
58	do	+++	do	—
59	do	+++	do	—
60	do	+	do	—
61	do	+	do	—
62	do	++	do	—
63	do	+++	do	—
64	do	++	Good	—
65	do	±	do	—
66	do		do	—

DISCUSSION

Preliminary experiment 1 shows clearly that carotene is present in cattle and carabao tissues, although it seems to occur in different forms. The difference in color of the residue of their ether extract or ether-benzine extract cannot be taken as an indication of the difference in the concentration of amounts of carotene in the tissue of the two animals, because in some cases even the colorless carabao residue gave a stronger reaction with the antimony trichloride test. Another evidence that carotene occurs in different forms in the tissue of these animals is the observation derived from preliminary experiment 2, where the colorless benzine extract of carabao tissue evaporated to dryness gave light-yellow oily residue which also gave just as strong positive reaction with antimony trichloride solution as given by the deeper colored yellow oily residue of the benzine extract from cattle tissue.

It is obvious that by the methods of extraction used in this work carotene is not extracted in pure form but in association with some fatty substances; but even in such impure state it can be recognized in the cattle and carabao tissue in more or less equal quantities, although in the latter animal it appears to occur in a different form. Carotene in carabaos seems to occur in hydrogenated form, like the octadecahydrocarotene or dihydrocarotene described by Smith,(6) the first substance as a colorless, oily product, and the second, as a viscous, noncrystallizable, pale-yellow substance which in solution of minute quantity may not be capable of imparting color to the solvent; while the carotene present in cattle tissue is of the highly colored form, like alpha carotene or beta carotene, which in solution even in minute quantities imparts visible color to the solvent. This difference in the nature of the carotene occurring in these two animals was taken advantage of in the differentiation of their flesh by the foregoing methods.

In the endeavor to develop methods of differentiation of the meat of the two animals treated in this work, it has always been the prime aim of the authors to find a simple rapid test, easy in procedure, requiring simple apparatus and reagents which are stable, so that no error can arise from deteriorating reagents or mixtures of reagents, and which possesses a high degree of accuracy so that it can be performed by veterinarians without special laboratory training. It is believed that these requirements are met by the two methods herein described. Although the total carotene content is not extracted in either of the two methods described, these methods give easily readable results, and thus far, as supported by the data included in this work, they possess a high degree of accuracy. As to rapidity, by the evaporation method the test of one sample can be finished in a half hour, and by the direct method in 10 minutes.

It has been found in a few trials that these methods may be useful in differentiating treated materials; such as meat boiled with condiments, fried in lard, or salted and dried. This phase of the problem will be treated in a subsequent work.

CONCLUSIONS

1. There is strong evidence of the presence of carotene in the tissues of cattle and carabaos, but in the latter animals it seems to occur in a different form.

2. Differentiation of unrefrigerated and frozen meat of cattle and carabaos is practicable by the two methods described; these methods are based on the difference in the nature of carotene present in the tissues of these two animals.

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistance given by Drs. Juan C. David, Enrique Salafranca, Tomas Siasoco, and Isidro L. Mendoza in the pursuance of this work.

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ILLUSTRATIONS

PLATE 1

Color of residues obtained from representative cattle-meat and carabao-meat samples by the evaporation method.

PLATE 2

Coloration of benzine layer obtained from representative samples of cattle meat and carabao meat by the direct reading method.

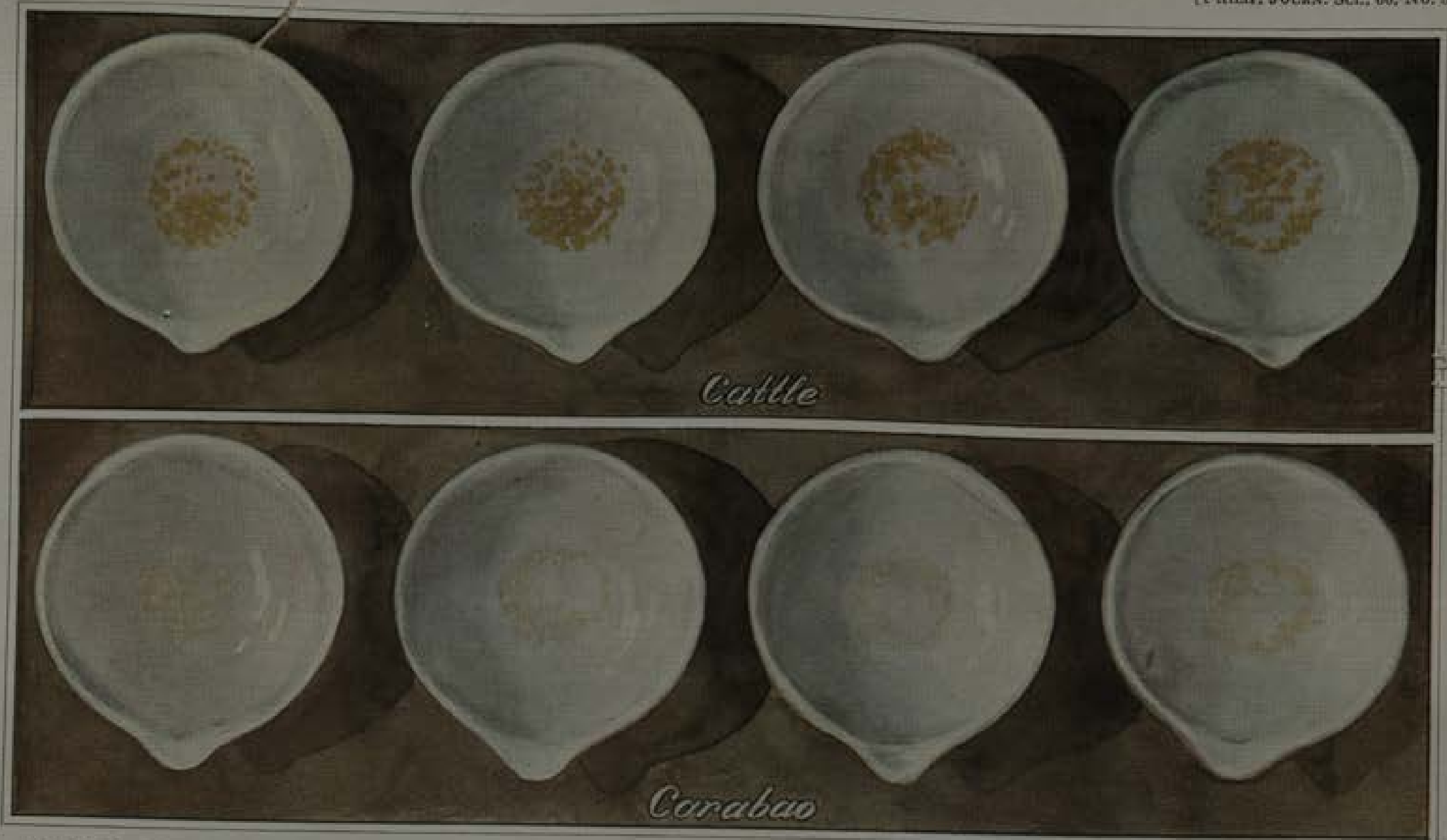

PLATE 1. COLOR OF RESIDUES OBTAINED FROM REPRESENTATIVE CATTLE-MEAT AND CARABAO-MEAT SAMPLES BY THE EVAPORATION METHOD.

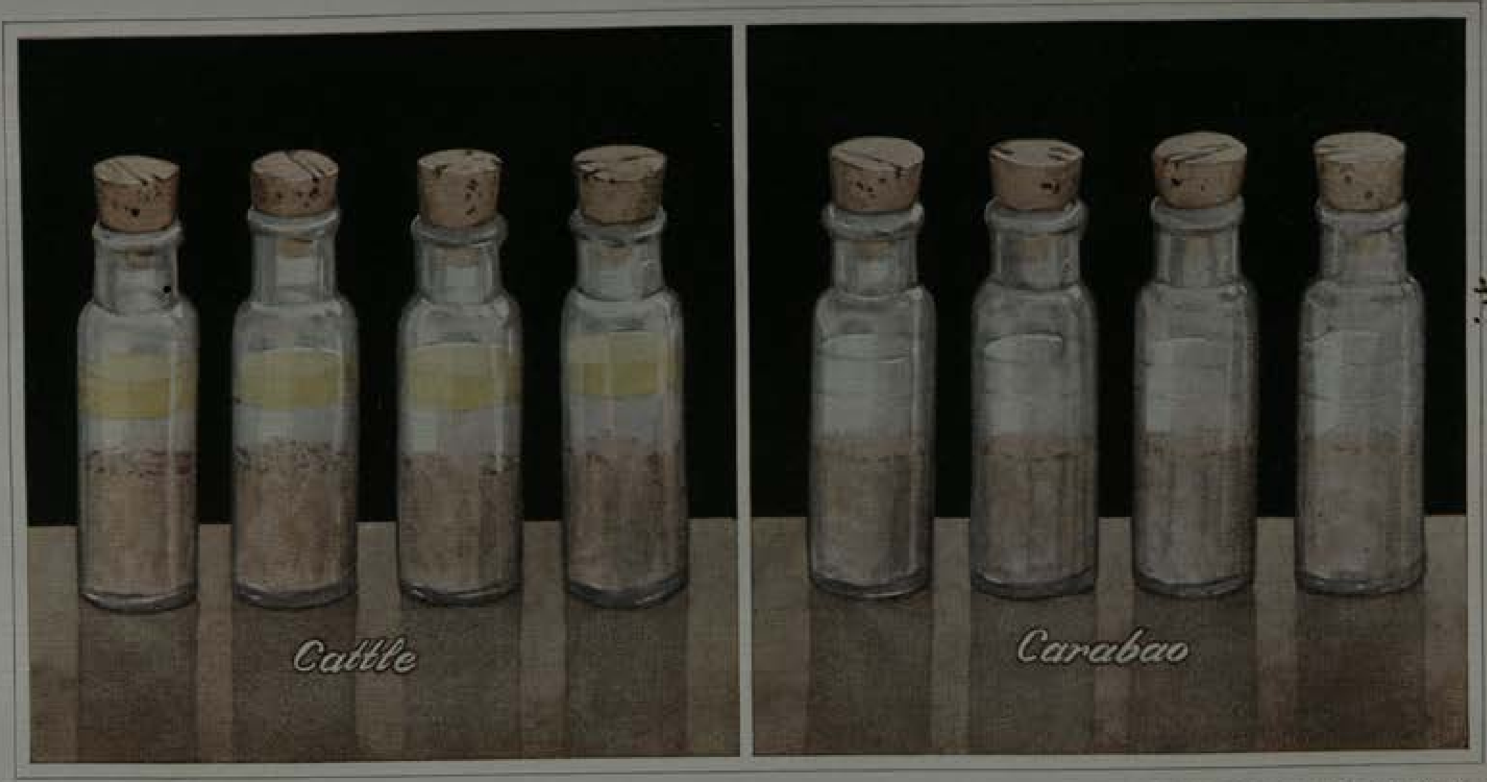

PLATE. 2. COLORATION OF BENZINE LAYER OBTAINED FROM REPRESENTATIVE SAMPLES OF CATTLE MEAT AND CARABAO MEAT BY THE DIRECT READING METHOD.

DESCRIPTION OF THREE TREMATODES OF THE GENUS HAPLORCHIS (HETEROPHYIDÆ) WITH NOTES ON TWO OTHER PHILIPPINE MEMBERS OF THIS GENUS.[1]

By CANDIDO M. AFRICA

Of the School of Hygiene and Public Health, University of the Philippines Manila

TWO PLATES

In this paper are described two new species of heterophyid trematodes belonging to the genus *Haplorchis.* In addition *Monorchotrema calderoni* Africa and Garcia (1935) which, in accordance with the recent studies of Chen (1936), apparently establishing the synonymy of the genus *Monorchotrema* and the genus *Haplorchis,* should now be called *Haplorchis calderoni* (Africa and Garcia, 1935), is redescribed and refigured because of some errors lately found in the original description. Brief notes on *Haplorchis yokogawai* (Katsuta, 1932) Chen, (1936) and *H. taichui* (Nishigori, 1924) Chen (1936) are also included.

HAPLORCHIS CALDERONI (Africa and Garcia, 1935). Plate 1, fig. 1.

In the revision of the original description of this species a considerable number of mounted specimens were restudied. In addition a large number of specimens in various stages of development from the freshly excysted to the adult stage, obtained from experimentally infected animals, were studied in the fresh state. This study afforded an excellent opportunity to determine the structure of the ventrogenital sac, especially the spines ornamenting the surface of the gonotyl which are very difficult to see in mounted stained adult specimens.

Body small, 0.47 to 0.55 mm long, 0.25 to 0.26 mm wide, pear-shaped, covered with scalelike spines except at posterior end. Oral sucker subterminal, 0.05 mm in diameter; prepharynx short; pharynx ovoid, 0.03 mm by 0.027 mm; œsophagus long and capillary, 0.150 mm long, 0.015 mm wide; intestinal cæca

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[1] Aided by a special research grant from the Board of Regents, University of the Philippines.

tubular, extending to posterior end of body, beyond posterior border of testis.

Genital sac ringlike, 0.035 to 0.040 mm in diameter, situated in the median line immediately behind intestinal bifurcation and occupied by a small protrusible gonotyl ornamented with extremely minute spines generally distributed within a circular area, 0.010 to 0.015 mm in diameter in its central surface. At the bottom of the genital sac, and continuous with the gonotyl, is the rudimentary acetabulum, 0.021 to 0.035 mm in diameter.

The single, large, spherical or slightly ovoid testis, 0.108 to 0.126 mm in diameter, occupies the median field of the posterior third of the body. The seminal vesicle consists of three very unequal parts; the first or posterior portion is a small ovoid thin-walled sac, 0.047 mm long, 0.042 mm wide, bent under the very much larger and longer second or expulsor portion from which it is separated by a short constriction. The expulsor is enormously long, 0.23 to 0.35 mm long, 0.035 to 0.056 mm wide, with a thick (0.0035 to 0.0040 mm) chitinized wall, running alongside and under the left cæcum towards the ventrogenital sac where it terminates by a short ejaculatory duct in common with the vagina. Ovary roundish, 0.055 to 0.080 mm in diameter, situated in the right side of the body about halfway between the testis and the ventrogenital sac. Receptaculum seminis spherical, 0.070 to 0.103 mm in diameter, situated at the right side opposite the seminal vesicle, between the testis and the ovary. The oviduct descends from the inferior border of the ovary and meets the tube coming from the receptaculum seminis to form a common duct which proceeds medially towards the oötype. The uterus descends at the left side of the body, and after describing several coils in the posterior half of the body ascends at the right side alongside the right cæcum and then turns medially toward the ventrogenital sac where it terminates in a vagina with denticulated inner lining in common with the ejaculatory duct. The vitellaria are composed of small follicles arranged in groups distributed in the posterior third of the body behind the seminal vesicle.

Eggs, 0.021 to 0.025 mm by 0.011 to 0.015 mm.

Hosts.—Dogs, cats, and man.

Location.—Small intestine.

Locality.—Manila, Philippines.

Type specimens and paratypes in the Parasitological Collection, Department of Parasitology, School of Hygiene and Public Health, University of the Philippines.

Haplorchis calderoni differs from all other species of the genus by the extraordinarily long second or expulsor portion of the seminal vesicle. Lately this species has also been recovered at autopsy from the small intestine of two native Filipinos, so that it is the fifth member of the family found naturally infecting man in the Philippines.

HAPLORCHIS VANISSIMA sp. nov. Plate 2, figs. 1 to 4.

The following description is based on the study of seven adult specimens recovered from the intestinal scrapings of an adult male Filipino, native of Bohol island, whose body was brought for autopsy to the Manila City Morgue, with a history of sudden death and with anatomic diagnosis of extensive capillary hæmorrhages in the brain. As far as could be determined, the patient had never been outside the Philippines. The material obtained was studied in the fixed and stained state.

Body ovoid or elongate, 0.375 to 0.512 mm long, 0.25 to 0.312 mm wide, covered with minute scalelike spines except at posterior extremity. Oral sucker subterminal, 0.049 mm to 0.060 mm in diameter; prepharynx short; pharynx 0.028 mm to 0.038 mm long, 0.018 to 0.035 mm wide; œsophagus 0.043 to 0.060 mm long, 0.017 mm wide; intestinal cæca extending posteriorly beyond posterior margin of testis.

Genital sac voluminous, 0.143 to 0.168 mm long, 0.105 to 0.120 mm wide, situated transversely across median field considerably beyond middle of body, pushing upward the intestinal bifurcation in most specimens. Genital sac occupied by a large oval and peculiarly ornamented gonotyl, 0.094 to 0.120 mm long, 0.087 to 0.105 mm wide. The ventrogenital sac is the most prominent structure in the fluke. Surface of gonotyl partially covered with spines, larger and more thickly set at edge and becoming smaller and rarer centripetally until they abruptly disappear completely in the central area. The spines, which vary in length from 0.0042 to 0.0085 mm, bear a striking resemblance to bamboo shoots (Plate 2, fig. 2), being septate; septa 2 or 3, the topmost conical. Left pole of gonotyl capped with a group of small (0.0015 to 0.0054 mm in diameter), glistening, white, polygonal plates, plates 28 to 32, with pavementlike arrangement, and apparently held in position by a pair of large, clawlike, chitinous, highly refractile plates (0.033 to 0.042 mm long from tip to tip, 0.025 to 0.027 mm wide at widest point), (Plate 2, fig. 3), which lend a grotesque appearance to the fluke.

The single testis, 0.112 to 0.176 mm long, 0.070 to 0.155 mm wide, transversely oval, median in location in posterior quarter of body, somewhat removed from posterior extremity. Seminal vesicle voluminous, 0.157 mm long, 0.112 mm wide, placed on left side between testis and ventrogenital sac. Ovary oval, 0.087 mm long, 0.057 mm wide, immediately in front of testis but inclined to right side of body. Receptaculum seminis 0.054 mm long, 0.45 mm wide, placed along left side of ovary but somewhat anterior to latter. Uterine coils all behind ventrogenital sac. Vitelline glands consist of small follicles arranged in groups, all behind seminal vesicle.

Eggs 0.025 to 0.030 mm by 0.018 to 0.021 mm.

Host.—Man.

Location.—Small intestine.

Locality.—Bohol (?), Philippines.

Type specimen and paratypes in the Parasitological Collection, School of Hygiene and Public Health, University of the Philippines.

Haplorchis vanissima is easily distinguished from all known members of the genus by the extraordinarily large gonotyl and by the peculiar ornamentation of this organ, particularly the presence of a pair of large clawlike chitinous plates and the large segmented spines peripherally distributed. *H. vanissima* is the sixth member of the family found as a natural parasite in the small intestines of man in the Philippines.

HAPLORCHIS SISONI sp. nov. Plate 1, figs. 2 and 3.

In the course of experimental feedings of various laboratory animals to determine the piscine hosts of Philippine heterophyids a large number of specimens of a trematode of this group were collected from the small intestine of several pups and kittens previously fed with metacercariæ obtained from *Therapon argenteus*. On examination they were found to represent a new species of *Haplorchis*, which we have the pleasure to name after Dr. Antonio G. Sison, Director of the School of Hygiene and Public Health, University of the Philippines. The following description is based upon the examination of a large number of both fresh and mounted specimens.

Body pyriform, small, 0.336 to 0.364 mm long, 0.225 to 0.315 mm wide. Cuticle covered with small scalelike spines except at posterior half of body. Oral aperture subterminal; oral sucker 0.042 mm in diameter; prepharynx short; pharynx 0.03 mm long, 0.027 mm wide; œsophagus capillary, 0.070 to 0.075

mm long; intestinal cæca relatively short, bulky, extending posteriorly only as far as level of middle of testis.

Genital sac ringlike, median, close to and directly behind bifurcation of intestines, 0.015 mm in diameter, occupied by a small protrusible gonotyl, the surface of which is covered with extremely minute but numerous spines generally distributed within a circular area in the center which is only about 0.010 mm in diameter. At base of gonotyl inside genital sac a rudimentary acetabulum, 0.015 to 0.020 mm in diameter.

The single roughly oval testis relatively large, 0.105 to 0.122 mm long, 0.067 to 0.077 mm wide, lying transversely in median field of posterior third of body. Seminal vesicle consisting of three distinct parts located between testis and left intestine, the first portion which is thin-walled and distinctly saclike, 0.065 to 0.070 mm long, 0.030 to 0.035 mm wide, bent under second or expulsor portion from which it is separated by a short constriction. Expulsor very prominent, 0.126 to 0.135 mm long, 0.033 to 0.035 mm wide, with chitinized walls, 0.0035 to 0.0045 mm thick. Parallel transverse striations present in the inner lining. Expulsor running alongside and under left intestine medially towards ventrogenital sac, where a short likewise thick-walled ejaculatory duct which arises from it terminates in common with vagina.

Elongate ovary 0.049 mm long, 0.033 mm wide, on right side of body in front of testis but closer to ventrogenital sac. Spherical receptaculum seminis 0.060 to 0.065 mm long, 0.030 to 0.033 mm wide, between testis and ovary although more externally situated. Oviduct arising from inferior border of ovary as a short tube which unites with the one coming from the receptaculum seminis to form a common duct which proceeds to the left side of the body alongside the anterior border of the testis. Uterine coils all behind ventrogenital sac. Vitellaria consisting of small follicles arranged in groups all behind seminal vesicle.

Eggs oval with relatively prominent operculum, 0.026 mm long, 0.014 mm wide.

Hosts.—Cats and dogs, experimentally.

Location.—Small intestine.

Locality.—Manila, Philippines.

Type specimens and paratypes in the Parasitological Collection, Department of Parasitology, School of Hygiene and Public Health, University of the Philippines.

This species closely resembles *Haplorchis calderoni*, particularly in the construction of the ventrogenital sac; but whereas in

H. calderoni the expulsor may measure as long as from 0.230 to 0.350 mm, in *H. sisoni* the greatest length recorded for this organ is only 0.135 mm; and whereas the intestines in *H. calderoni* extend posteriorly beyond the posterior border of the testis, in *H. sisoni* they extend only as far posteriorly as the level of the middle of the testis. Furthermore, in *H. sisoni* the inner lining of the expulsor presents parallel transverse striations in the fresh preparation, which structure has never been noted in similar preparations of *H. calderoni*.

HAPLORCHIS TAICHUI (Nishigori, 1924) Chen, 1936.

Haplorchis taichui (Nishigori, 1924) CHEN, 1936.
Monorchotrema taichui NISHIGORI, 1924.

A careful comparison of the Philippine specimens assigned to this species with paratypes of the same kindly furnished for this study by Professors S. Yokogawa, of the Imperial University of Taihoku, Formosa, and H. T. Chen, of the Department of Biology, Lingnan University, Canton, China, has disclosed no significant differences between the Philippine and foreign specimens. Professor Chen, who has examined several mounted Philippine specimens of this species sent to him by the author, stated in a personal communication to the latter that the Philippine and the Chinese materials are identical. During the writing of this paper several specimens of *H. taichui* were received from Palestine through the courtesy of Professor Witenberg, of Hebrew University, Jerusalem, which upon comparison with the local specimens again showed no differences. On the basis of these observations it is believed that the Philippine material can be correctly assigned to *H. taichui*. In the Philippines this parasite has been recorded from man, dogs, cats, and cattle egrets as a natural infection.

HAPLORCHIS YOKOGAWAI (Katsuta, 1932) Chen, 1936.

Haplorchis yokogawai (Katsuta, 1932) CHEN, 1936.
Monorchotrema yokogawai KATSUTA, 1932.

Philippine specimens of this heterophyid were erroneously assigned by Africa and Garcia (1935) to *Monorchotrema taihokui* Nishigori, 1924, the synonymy of which with *Haplorchis pumilio* (Looss, 1899) seems to have been established by Chen (1936). Prior to the work of Chen, Witenberg (1929, 1930) pointed out that *Monorchotrema taihokui* and *Haplorchis pumilio* are identical. Prior to the appearance of Chen's paper, however, no description was available of *Haplorchis yokogawai* (*Monor-*

chotrema yokogawai) except in Japanese. Upon reading the clear description of this trematode in Chen's paper in English the present author realized that the Philippine material should have been assigned to *Haplorchis yokogawai* instead of to *H. pumilio*. This view was confirmed when the Philippine specimens were compared with paratypes of *H. yokogawai* kindly furnished the author by Professor Chen. Philippine specimens have been found identical with the Chinese material. Comparison was also made with one specimen labeled *Monorchotrema yokogawai*, furnished by Professor Yokogawa from Formosa, and the latter was also found identical with the Philippine specimens. Chen (1936) believes that the Chinese and Formosan specimens are identical. The latter author, when furnished with several mounted specimens of our local material, declared in a personal communication that these clearly belong to *H. yokogawai*. The Philippine specimens may, therefore, be correctly assigned to *Haplorchis yokogawai*, the heterophyid not only the most frequently encountered in man in this country but also the most frequently associated with cardiac failure. Moreover, this trematode has been found as a natural infection not only in man but also in dogs, cats, and cattle egrets, and has been experimentally reared not only in these latter animals but also in *Strix whiteheadi*, *Pyrreroidios manilensis*, and *Macacus cynomolgus*.

ACKNOWLEDGMENTS

The writer is indebted to Prof. S. Yokogawa, of Taihoku Imperial University, Taiwan (Formosa), to Prof. H. T. Chen, of the Department of Biology, Lingnan University, and to Prof. G. Witenberg, of Hebrew University, Jerusalem, for their kindness in sending specimens of *H. yokogawai* and *H. taichui* for comparison with local specimens. Thanks are also due to Drs. Vasquez-Colet and E. Y. Garcia, staff members of the Department of Parasitology, University of the Philippines, for technical assistance.

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ILLUSTRATIONS

[*ed*, Ejaculatory duct; *int*, intestine; *gtl*, gonotyl; *oe*, œsophagus; *os*, oral sucker; *ov*, ovary; *ph*, pharynx; *rac*, rudimentary acetabulum; *rs*, receptaculum seminis; *sv*, seminal vesicle; *t*, testis; *vag*, vagina; *vg*, vitelline gland; *vgs*, ventrogenital sac.]

PLATE 1

FIG. 1. *Haplorchis calderoni* (Africa and Garcia, 1935); entire worm, ventral view.

2. *Haplorchis sisoni* sp. nov.; entire worm, ventral view.
3. Microdrawing of a sagittal section of *H. sisoni*; rudimentary acetabulum.

PLATE 2

FIG. 1. *Haplorchis vanissima* sp. nov.; entire worm, ventral view.

2. Different types of spines ornamenting gonotyl of *H. vanissima*.
3. Camera lucida tracing of the ventrogenital-sac complex of *H. vanissima*; ornamentations of gonotyl.
4. Photomicrograph (h. p.) of the ventrogenital-sac complex of *H. vanissima*; spines, the two clawlike plates, and the polygonal scales in pavementlike arrangement.

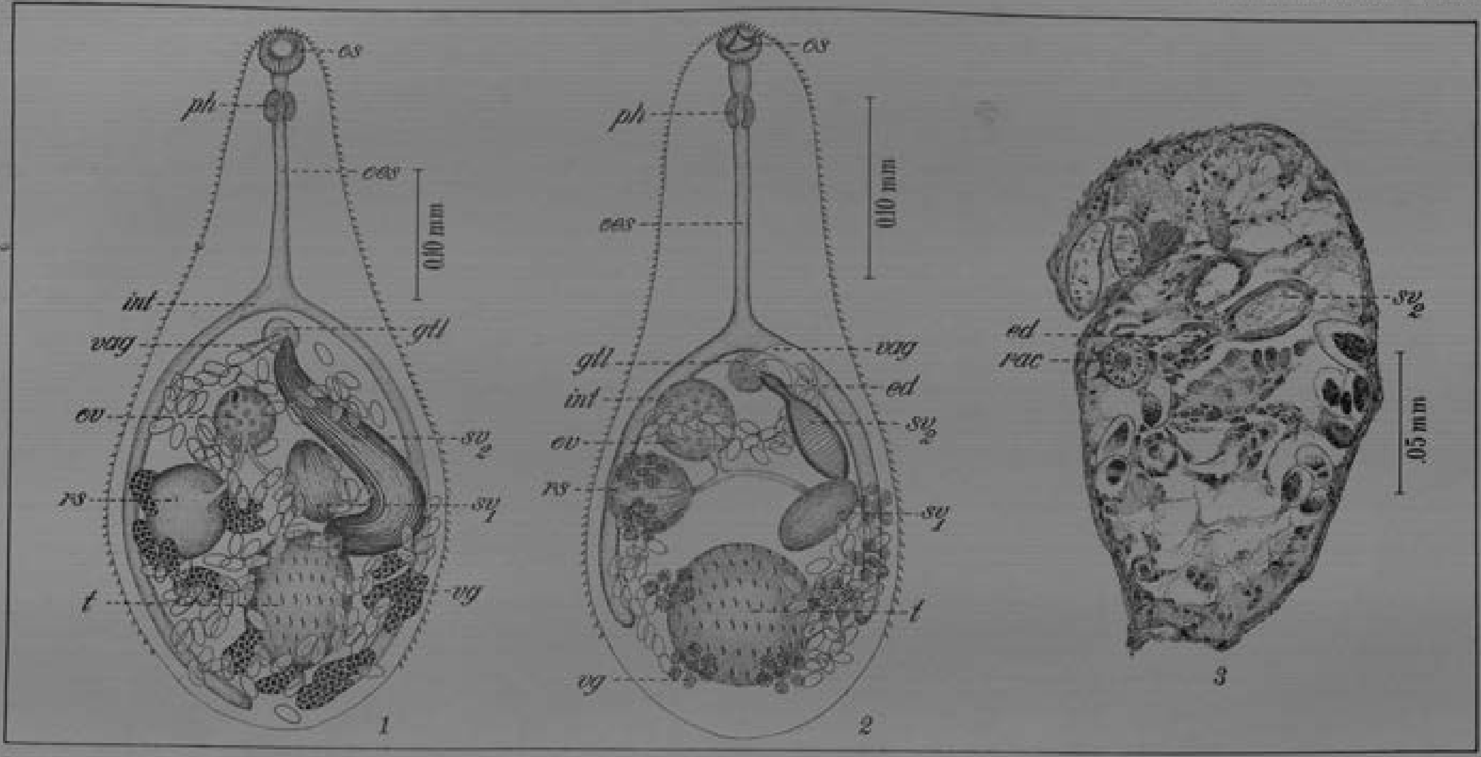
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PLATE 1.

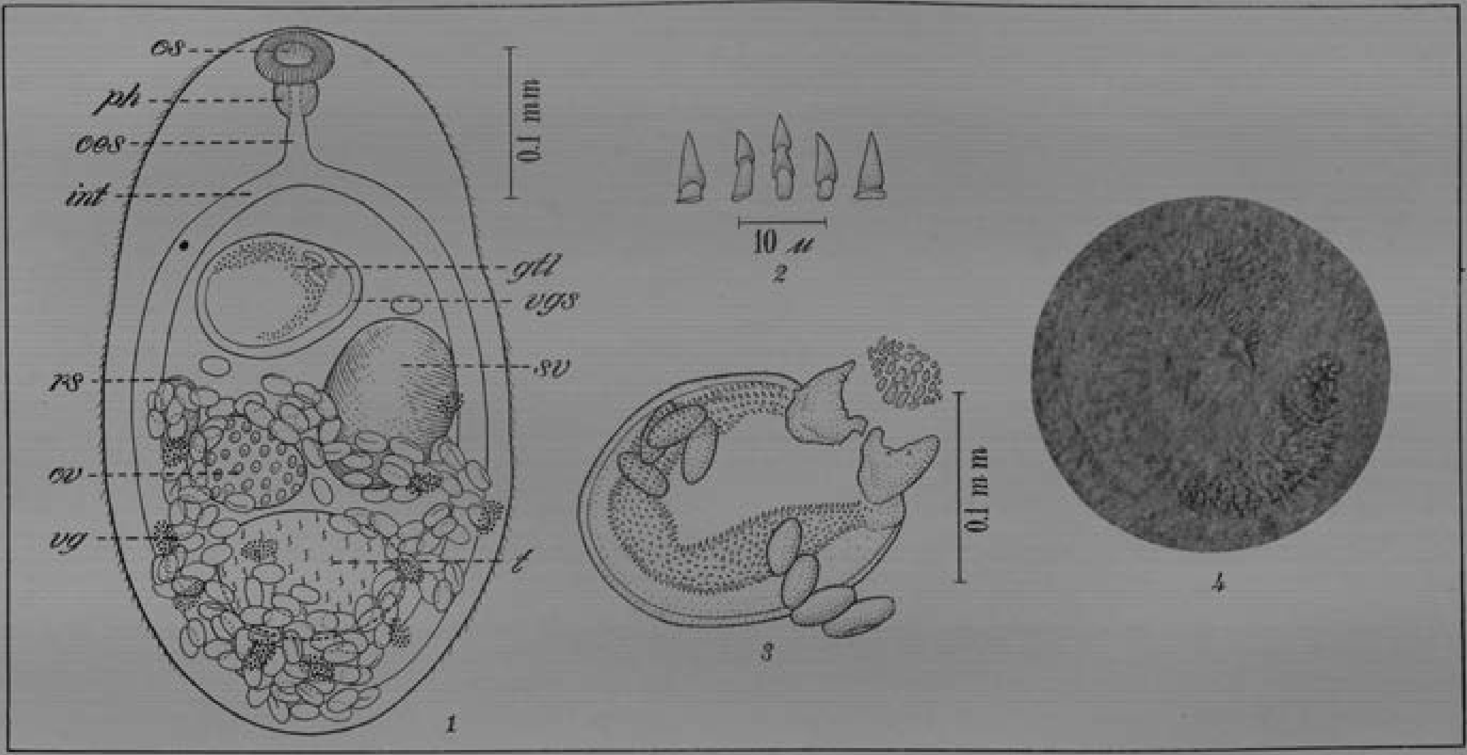

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXVIII[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

THREE PLATES

The species of crane flies described in this paper were taken in Szechwan Province, western China, by Mr. Tsen Bao-chi, native collector for the Reverend Mr. George M. Franck, who likewise secured a portion of the material. Mr. Tsen's collections were taken at various altitudes on Mount Omei between June 5 and 13, 1937, and indicate a rich and varied spring fauna as occurring on these mountains. I express my deep indebtedness to Messrs. Franck and Tsen for the opportunity of studying this interesting collection. The types of the included novelties are preserved in my extensive series of these flies. I am including a single species of the allied family Trichoceridæ.

TRICHOCERIDÆ

TRICHOCERA APPENDICULATA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

Large (wing, male, 8 millimeters); general coloration black; halteres very long, stem yellow, knob dark; legs dark brown; wings slightly tinged with brown, with a slightly darker brown cloud on r-m; abdomen, including hypopygium, black; male hypopygium with dististyle profoundly bifid, the two arms subequal in length, the outer slenderer; from the apparent ninth sternite arises a long, depressed appendage, jutting caudad to opposite or beyond level of other structures of hypopygium.

Male.—Length, about 7 millimeters; wing, 8.

Rostrum and palpi black. Antennæ brownish black throughout, moderately long, if bent backward extending to some distance beyond base of abdomen. Head black.

Thorax uniformly blackened. Halteres remarkably long and slender, if bent backward extending to nearly opposite outer end of second abdominal segment; stem yellow, knob small, brownish black. Legs dark brown. Wings (Plate 1, fig. 1) with a slight brown suffusion; a vague, slightly darker brown cloud on r-m; veins pale brown. Macrotrichia of veins relatively short. Venation: Sc_2 shortly before midlength of Rs; basal section of R_3 very short, r-m correspondingly lengthened; petiole of cell M_1 a little shorter than second section of vein M_{1+2}.

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[1] Contribution from the entomological laboratory, Massachusetts State College.

Abdomen, including hypopygium, black. Male hypopygium with dististyle (Plate 2, fig. 25, *d*) profoundly bifid at near midlength; stem stout, outer arm much slenderer, its outer surface with scattered coarse setæ, inner or mesal face with long delicate setæ; inner arm or lobe about equal in length to outer, more flattened, especially at near midlength, apex gradually narrowed into a slender point, extreme tip curved; distal half of arm pale, lower margin with a series of 15 to 18 small setæ. Gonapophyses of moderate length. From what appears to be the ninth sternite, but which cannot be definitely recognized from the unique slide type, projects a depressed, dark-colored lobe, narrower at base, gently widened outwardly, median area further produced into a narrower lobe that is densely provided with coarse black setæ; lateral shoulders of appendage with very long coarse setæ that jut caudad to beyond level of median lobe.

Habitat.—China (Szechwan).

Holotype, male, Kwanhsien, altitude 3,500 feet, December, 1936 (*Franck*).

Trichocera appendiculata is very distinct from all described members of the genus. The remarkable structure, apparently borne by the last abdominal sternite, is unique among the species so far described.

TIPULIDÆ

TIPULINÆ

TANYPTERA ANTICA sp. nov. Plate 1, fig. 2.

Small (wing, male, under 10 millimeters); general coloration black, thorax and first abdominal tergite roughened alutaceous; halteres yellow throughout; legs reddish, fore tibiæ with a broad white ring before tips; wings strongly suffused with brown, base more yellowish; stigma subcircular, darker brown; cell 1st M_2 small, pentagonal; abdominal tergites broadly black medially, reddish yellow on sides.

Male.—Length, about 12 millimeters; wing, 9.5; antennæ, about 4.

Frontal prolongation of head black, with dense yellow setæ; palpi pale brown, outer segments darker. Antennæ black, pedicel reddish brown; antennæ moderately long, if bent backward extending about to halteres; basal flagellar branches moderately long, longest (about flagellar segment seven or eight) about one and one-half as long as segment; unpaired branch about one-half length of paired branches. Head black, subnitidous.

Thoracic dorsum black, surface only faintly nitidous, interspaces with conspicuous yellow setæ; surface of usual præscutal stripes faintly alutaceous; scutellum and postnotum more conspicuously roughened. Pleura and pleurotergite dull black, surface conspicuously roughened, alutaceous. Halteres pale yellow. Legs with coxæ dull black, with a dense white pubescence; trochanters pale yellow; fore femora reddish brown, narrowly yellow at base; fore tibiæ brownish black, with a broad white ring before narrow darkened tip, this ring occupying about one-third total length of tibia; fore tarsi passing through dark brown to black; middle and posterior femora reddish, tibiæ and tarsi more obscure yellow, terminal segments infuscated. Wings (Plate 1, fig. 2) with a strong brown suffusion, prearcular field, cells Sc and Cu_1, and base of cell 2d A, more yellowish; stigma subcircular, darker brown; a weak dark cloud on anterior cord; pale obliterative areas before stigma, across end of Rs and involving base of cell 1st M_2; veins dark brown, more yellowish in brightened areas. Venation: Tips of Sc_1 and free tip of Sc_2 atrophied; R_{1+2} entire, suberect; Rs short, arcuated; veins of outer radial field short; cell M_1 about three times its petiole, latter longer than m; cell 1st M_2 small, pentagonal; vein M_4 bent strongly backward, so cell M_3 at margin considerably wider than cell M_1.

Basal abdominal tergite dull black, alutaceous; succeeding tergites broadly black medially, reddish yellow on sides, subterminal segments and hypopygium black; sternites reddish yellow.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 12, 1937 (*Tsen*).

Tanyptera antica is readily told from other small species in eastern Asia, such as *T. angustistyla* Alexander, by the dull alutaceous surface of the thorax and basal abdominal tergite, the broad white ring on the fore tibia, yellow halteres, and details of venation, as the entire R_{1+2}.

DICTENIDIA GLABRATA sp. nov. Plate 1, fig. 3.

General coloration polished yellow, præscutum and scutal lobes chiefly polished black; antennal flagellum brownish black; pronotum and pleura yellow; posterior legs not conspicuously enlarged or hairy; tibiæ black, with a narrow white ring near base; wings faintly yellow, sparsely patterned with brown, including tip and a complete but narrow band at cord; cells of wing without macrotrichia; abdominal tergites brownish yellow, trivittate with black; basal sternites with a median black stripe.

Female.—Length, about 16 millimeters; wing, 12.

Frontal prolongation of head brownish yellow, nasus conspicuous; palpi with basal segment brown, remainder black. Antennæ (female) apparently 11-segmented, outer flagellar segments short, crowded, more or less consolidated; scape and pedicel pale yellow, flagellum uniformly brownish black. Front yellow, broad anterior vertex polished black; genæ and occiput obscure yellow.

Pronotum uniformly yellow. Mesonotal præscutum almost covered by three polished black stripes, restricting ground color to narrow obscure yellow intermediate lines; scutal lobes similarly blackened, median area, together with posterior sclerites of notum, obscure polished yellow. Pleura, including dorsopleural membrane and pleurotergite, yellow. Halteres with stem and base of knob dusky, apex of knob yellow. Legs with coxæ and trochanters yellow; fore and middle femora almost uniformly obscure brownish yellow, apex scarcely darker; tibiæ brown, tips brownish black; tarsi black; posterior legs longer and more powerful than the others but not so markedly so as in *D. formosana*, *D. pictipennis*, and *D. luteicostalis* among the species in eastern Asia; legs not conspicuously hairy; posterior femora obscure yellow, tips narrowly but conspicuously blackened, preceded by a similarly narrow, clearer yellow ring; tibiæ black with a narrow white ring placed a little more than its own length beyond base; tarsi black. Wings (Plate 1, fig. 3) with a faint yellow tinge, prearcular and costal portions deeper yellow; a restricted brown pattern, as follows: A narrow band at cord, completely traversing wing from stigma to posterior margin; wing tip narrowly darkened, involving cells R_3 to M_1, inclusive; a linear brown streak in center of cell R, more widened in basal portion, extending beyond origin of Rs which is likewise slightly clouded; veins black, including those in brighter costal portion. Cells of wing without macrotrichia, as in *inæquipectinata*. Venation: Rs more than twice m-cu; petiole of cell M_1 subequal to m.

Abdominal tergites obscure brownish yellow, beyond first segment with three narrow black stripes, median broader than laterals; extreme caudal borders on either side of median stripe clearer yellow; sternites brownish yellow, basal and intermediate segments blackened medially; subterminal segments and genital shield polished black; cerci horn-yellow.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, altitude 5,000 feet, June 5, 1937 (*Tsen*).

The only described species of *Dictenidia* without macrotrichia in the outer cells of wing is *D. inæquipectinata* Alexander, of the high mountains of Formosa. In its wing pattern the present fly is most like the genotype, *D. bimaculata* (Linnæus), of the northern Palæarctic region, which differs from *glabrata* in the apically pilose wings and in the very different leg pattern. The latter character is much like that of many species of *Pselliophora* Osten Sacken, but the present fly is a true *Dictenidia*. In an earlier report under this general title,[2] I have indicated the increasing difficulties in the generic separation of the females of the Ctenophoraria.

Since the above was written, a male specimen has come to hand that I believe represents this sex of the present fly. It differs from the description given, as follows:

Head above yellow, with a transverse band across the anterior vertex, this marking trilobed across anterior border. Antennæ (male) with branches elongate, distal branch a little slenderer than basal branch and ranging from two-thirds to three-fourths as long. Præscutum with three separate black stripes, laterals crossing suture and covering centers of scutal lobes. Wings unmarked except for the brownish black stigma, a broad brown seam on anterior cord, and a narrower brown seam on m-cu. Petiole of cell M_1 shorter than m. Abdominal tergites trivittate, the median stripe narrower on cephalic portion; fifth and succeeding segments uniformly blackened.

Allotype, male, Pehlüting (White Deer Mountain), altitude 6,000 feet, July 11, 1937 (*Franck*).

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[2] Philip. Journ. Sci. 60 (1936) 167, 168.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) IMPROVISA Alexander.

Limonia (Limonia) improvisa ALEXANDER, Philip. Journ. Sci. 51 (1933) 535, 536.

The types were taken from the China-Tibet border at high altitudes. One male, White Cloud Temple, Mount Omei, altitude 9,000 feet, June 12, 1937 (*Tsen*). This specimen is larger than the types (male, length, about 11 millimeters; wing, 14) with the wing pattern heavier, especially the major dark areas at cord, origin of Rs, and beyond the arculus.

LIMONIA (LIMONIA) PERBEATA sp. nov. Plate 1, fig. 4; Plate 2, fig. 14.

General coloration of thorax uniformly polished black; antennæ black, outer flagellar segments progressively lengthened; halteres elongate, knobs very weakly darkened; legs with fore coxæ black, remaining coxæ and all trochanters yellow; fore femora with outer end extensively blackened, posterior femora with tips narrowly so; tibiæ obscure yellow; wings yellowish subhyaline, with a restricted brown pattern, including all of cell C; vein Sc short, Rs spurred at origin; male hypopygium with dististyle produced into a long yellow beak; gonapophyses with mesal-apical lobes dark brown, broad; ædeagus terminating in two divergent points.

Male.—Length, about 6.5 millimeters; wing, 8.

Rostrum and palpi black. Antennæ black throughout; basal flagellar segments short-oval, with short apical necks; outer segments becoming more elongate, last about one and one-half as long as penultimate; verticils of outer segments subequal in length to segments themselves. Head dark gray; anterior vertex narrow, about two-thirds diameter of scape.

Thorax uniformly polished black. Halteres elongate, pale yellow, knobs very weakly darkened. Legs with fore coxæ brownish black, remaining coxæ light yellow; trochanters yellow; femora yellow basally, tips blackened, very broadly so on forelegs where only about proximal fourth is yellow; posterior femora yellow, with about distal ninth darkened; remainder of legs obscure yellow, outer tarsal segments passing into brownish black; claws with a single slender basal spine, about one-third as long as claw itself. Wings (Plate 1, fig. 4) yellowish subhyaline, restrictedly patterned with brown; cell C uniformly darkened, cell Sc darkened on basal half; brown seams at fork of Sc, origin of Rs, R_2, cord, and outer end of cell 1st M_2; veins brownish yellow, somewhat darker in clouded areas, paler at wing base. Venation: Sc short, Sc_1 ending about opposite one-third length of Rs, Sc_2 at its tip; Rs angulated and spurred at origin, spur nearly as long as basal section of Rs; free tip of Sc_2 nearly three times R_2; m-cu at fork of M.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 2, fig. 26) with tergite, *9t*, transverse, caudal margin straight. Dististyle, *d*, with body small, subequal to ventromesal lobe of basistyle, beak long-produced, yellow beyond base. Gonapophyses, *g*, with mesal-apical lobes darkened, broad, outer margin weakly roughened, apical spine short. Ædeagus, *a*, pale, at apex produced into two divergent points, surface with numerous microscopic spines that are directed outwardly.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

In general appearance similar to *Limonia* (*Limonia*) *anthracina* (Alexander) but entirely distinct, being most nearly allied to the almost uniformly yellow species *L.* (*L.*) *omniflava* Alexander, likewise from western China. In the black body coloration and restrictedly patterned wings the present fly bears a noteworthy superficial resemblance to *Limonia* (*Dicranomyia*) *lethe* sp. nov., *Limnophila* (*Prionolabis*) *carbonis* sp. nov., and *Elephantomyia* (*Elephantomyia*) *carbo* sp. nov., all from Mount Omei.

LIMONIA (DICRANOMYIA) TSENI sp. nov. Plate 1, fig. 4; Plate 2, fig. 27.

General coloration of mesonotum brownish yellow, pollinose; pronotum and cephalic half of præscutum with a narrow brownish black median stripe; femora yellow, tips narrowly brownish black; wings grayish subhyaline, stigma pale brown, inconspicuous; male hypopygium with caudal margin of tergite bearing a bilobed plate; basistyle with ventromesal lobe large, complicated by outgrowths and brushes; dorsal dististyle suddenly narrowed at tip; ventral dististyle with rostral region bifid; base of rostral prolongation with a slender arm, tipped with setæ.

Male.—Length, 7.5 to 8.5 millimeters; wing, 8.2 to 9.5.

Rostrum brown; palpi black. Antennæ with scape and pedicel black, flagellum brown; flagellar segments oval, terminal segment slightly longer than penultimate. Head blackish, sparsely pruinose.

Pronotum dark brown medially, yellow on sides. Mesonotum brownish yellow, pollinose, præscutum with a narrow brownish black median stripe that becomes obsolete at near midlength of sclerite. Pleura brownish yellow, pollinose. Halteres elongate, stem pale, knob dark brown. Legs with coxæ and trochanters yellow; femora yellow, tips rather narrowly brownish black, the amount subequal on all legs; tibiæ brownish yellow, tips very narrowly darkened; tarsi black; claws with a single long basal spine. Wings (Plate 1, fig. 5) faintly grayish subhyaline; stigma pale brown, inconspicuous; veins brown. Venation: Sc_1 ending shortly beyond origin of Rs, Sc_2 a little removed from its tip; Rs more than twice basal section of R_{4+5}; m-cu just beyond fork of M.

Abdominal tergites dark brown, sternites paler; hypopygium chiefly dark, ventral dististyle pale. Male hypopygium (Plate 2, fig. 27) very complex in structure, especially basistyle, *b*, and ventral dististyle, *vd*, general structure somewhat as in *grahamiana* but with the details quite distinct. Ninth tergite, *9t*, broadly transverse, caudal margin bearing a median projection that divides into two divergent lobes, separated by a narrow incision. Basistyle, *b*, with ventromesal lobe very broad and flattened, in the axil bearing a long pale lobe tipped with numerous setæ and flattened spines, with other hair brushes at base. Dorsal dististyle a gently curved rod, abruptly narrowed at apex into a straight spine. Ventral dististyle, *vd*, of moderate size, pale, fleshy; rostral prolongation stout, bifid, outer arm slender, tufted with setæ; lower arm truncated at apex, with a few setæ, including two stouter pendant setæ; rostral spines two, of moderate size, placed close together on face of rostrum at near midlength. From base of style, cephalad of prolongation, with a slender sclerotized arm, tipped with setæ. Gonapophyses, *g*, with mesal-apical lobe relatively slender, smooth.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotype, male, June 5, 1937.

The nearest described ally of the present fly is *Limonia* (*Dicranomyia*) *grahamiana* Alexander, of western China and Tibet, which differs in details of coloration, as the conspicuous wing stigma, and in the structure of the male hypopygium, especially the tergite and dististyles.

LIMONIA (DICRANOMYIA) LETHE sp. nov. Plate 1, fig. 6; Plate 2, fig. 28.

General coloration polished black; femora yellow, tips brownish black; wings yellow, costal and prearcular portions clearer yellow; a sparse dark pattern, including seams on cord, outer end of cell 1st M_2 and along vein Cu; Sc_1 terminating a short distance beyond origin of Rs; male hypopygium with a single rostral spine.

Male.—Length, 6.8 to 7 millimeters; wing, 7.2 to 7.5.

Female.—Length, about 8 millimeters; wing, 8.5.

Rostrum and palpi black. Antennæ with scape brown; pedicel obscure yellow; flagellum black. Head blackish gray; anterior vertex narrow, about one-half diameter of scape.

Thorax polished black throughout. Halteres pale yellow. Legs with fore and middle coxæ blackened, apex of latter pale, posterior coxæ yellow; trochanters yellow; femora yellow, tips brownish black, moderately wide and subequal on all legs; tibiæ obscure yellow, tips very narrowly darkened; basitarsi obscure yellow, remaining segments brown. Wings (Plate 1, fig. 6) yellow, costal and prearcular portions clearer yellow; a restricted brown pattern, including oval stigma, very narrow seams along cord and outer end of cell 1st M_2, and a wider seam on central portion of vein Cu in cell M; veins beyond cord and all of Cu except for base brown, remaining veins light yellow. Venation: Sc long for a member of the subgenus, Sc_1 ending about opposite one-sixth length of Rs, Sc_2 at tip; free tip of Sc_2 and R_2 in transverse alignment; cell 1st M_2 shorter than veins beyond it; m-cu at fork of M.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 28) with caudal margin of tergite, *9t*, with a deep V-shaped notch, lobes obtusely rounded. Dorsal dististyle sickle-shaped. Ventral dististyle, *vd*, small, its extent less than that of basistyle, subcircular to short-oval in outline; rostral prolongation powerful, beyond rostral spine narrowed and terminating in an acute blackened point; rostral spine single, from a scarcely developed tubercle, subequal in length to prolongation itself. Gonapophyses, *g*, with mesal-apical lobe slender, blackened. Ædeagus, *a*, relatively narrow.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Allotopotype, female. Paratopotype, male.

In its general appearance, especially the polished black color of the thorax, and in the structure of the male hypopygium, as the single rostral spine of the ventral dististyle, the present fly suggests members of the *morio* group, but I am not entirely convinced that it belongs there. It is very distinct from all described regional species of *Dicranomyia*, especially in the unusually long Sc, wing pattern, and structure of the male hypopygium.

ANTOCHA (ANTOCHA) FLAVIDIBASIS sp. nov. Plate 1, fig. 7.

General coloration light gray, præscutum with four stripes that are confluent or nearly so; antennæ black throughout; halteres with dark-brown knobs; femora brown, tibiæ and tarsi brownish black; wings pale gray, prearcular field conspicuously light yellow; stigma not or scarcely indicated; abdominal tergites dull black, sternites more grayish.

Female.—Length, about 8.5 millimeters; wing, 9.

Rostrum brown; palpi black. Antennæ black throughout; flagellar segments oval, outer segments more elongate. Head brown, front and anterior vertex, together with narrow posterior orbits, light gray, the two colors separated by a narrow darker line.

Pronotum and mesonotum light gray, disc of præscutum chiefly covered by four confluent or virtually confluent stripes; scutal lobes similarly darkened. Pleura gray. Halteres yellow, knobs dark brown. Legs with coxæ gray; trochanters black; femora brown, tibiæ and tarsi brownish black. Wings (Plate 1, fig. 7) tinged with pale gray, prearcular region clear light yellow, conspicuous; stigma not or scarcely differentiated against ground; veins pale brownish yellow, clear luteous in prearcular field. Venation: R_2 in transverse alignment with r-m; m-cu about one-fourth its length before fork of M.

Abdominal tergites dull black, sternites more grayish; genital shield blackened; cerci horn-colored, short but strong.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

Antocha (*Antocha*) *flavidibasis* is one of the largest species so far discovered. It is equal in size to *A.* (*A.*) *nebulipennis* Alexander, likewise from western China and the Tibet border, differing in the clear wings, without pattern, and with the base abruptly light yellow. The black antennæ, dark legs, and pale wing veins furnish additional characters that separate the fly from near relatives.

ANTOCHA (ANTOCHA) NEBULIPENNIS IMMACULATA subsp. nov. Plate 2, fig. 29.

Male.—Length, about 6 millimeters; wing, 7.

Differs from the typical form in the small size, unpatterned wings, and details of structure of the male hypopygium.

Antennæ (male) with scape obscure yellow, remaining segments black; flagellar segments oval, clearly delimited; antennæ relatively long, if bent backward ending a short distance before wing root. Mesonotum light gray, with three pale-brown stripes, broad median stripe very vaguely and indistinctly divided by a pale vitta. Halteres with stem obscure yellow, knob dark brown. Legs black. Wings whitish subhyaline, prearcular field yellow; stigma very small, indistinct; veins dark, vaguely bordered with darker, vein C paler. Venation: Rs very long, approximately three times R alone; cell 1st M_2 narrow; m-cu about one-third its length before fork of M.

Abdomen dark brown, pruinose; hypopygium dark. Male hypopygium (Plate 2, fig. 29) with the tergite, *9t*, conspicuously bilobed, contour of lobes about same as that of median notch. Apex of basistyle, *b*, only moderately produced. Outer dististyle, *od*, blackened, apex narrowed but not abruptly so, as in typical form. Gonapophyses appearing as straight acicular spines.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

The present fly is told from *Antocha* (*Antocha*) *flavidibasis* sp. nov. by the nature of the thoracic pattern and the darkened wing veins that contrast markedly with the ground.

PEDICINI

DICRANOTA (RHAPHIDOLABIS) PRÆCISA sp. nov. Plate 1, fig. 8; Plate 2, fig. 30.

General coloration gray, præscutum with four darker brown stripes; halteres dark brown, base of stem yellow; legs dark brown; wings subhyaline, ill-defined stigma pale brown; Rs weakly to strongly angulated at near midlength; R_2 oblique, close to tip of R_1; male hypopygium with caudal margin of tergite bearing two slender lobes; interbase a flattened plate with serrated margin; basistyle terminating in two lobes; dististyle a flattened mitten-shaped plate.

Male.—Length, about 6 millimeters; wing, 7.2.

Female.—Length, 7 to 7.5 millimeters; wing, 7.5 to 8.5.

Rostrum dark gray; palpi black. Antennæ black throughout, 15-segmented; flagellar segments beyond elongate basal segment oval. Head dark gray.

Rostrum and palpi white. Antennæ white throughout, short, if bent backward not quite reaching wing root. Head whitish.

Thorax uniformly pinkish white or yellowish white, sparsely dusted with white. Halteres white. Legs white, femoral tips in cases vaguely a little darker; terminal tarsal segments darkened. Wings (Plate 1, fig. 9) whitish; veins pale, variegated by very restricted darkened areas that are confined to actual veins, including h; arculus; origin of Rs; Sc_2; cord; fork of $R_{2,3,4}$; R_2, and outer end of cell 1st M_2. Venation: No supernumerary crossvein in cell R_1; cell 1st M_2 closed.

Abdomen pale, brownish white; hypopygium and subterminal segment brown. Male hypopygium (Plate 2, fig. 31) with general conformation much as in *dicranotoides*. Dististyle, *d*, long, slender, with setæ of various lengths at and near tip. Lateral tergal arms, *9t*, appearing as slender sinuous rods, tips narrowly obtuse. Interbase, *i*, much shorter, tips expanded into compressed blades.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female, June 5, 1937. Paratopotypes, several males and females, June 5 and 12, 1937.

By my key to the Japanese species of *Amalopina*[3] the present fly runs to *D.* (*A.*) *fumicosta* Alexander, of Formosa, a very different fly. In its general appearance the new species is most like *D.* (*A.*) *dicranotoides* (Alexander) which is readily distinguished by the presence of a supernumerary crossvein in cell R_1 of the wings.

DICRANOTA (AMALOPINA) HYALIPENNIS sp. nov. Plate 1, fig. 10.

Belongs to the *elegantula* group; thorax uniformly pale whitish; fore and middle femora black, remainder of legs whitened; wings hyaline, unmarked except for a darkening of veins comprising cord and origin of Rs; Sc_2 shortly before origin of the long Rs, latter subequal to R; R_2 transverse, longer than R_{1+2}.

Sex ?—Wing 6 millimeters.

Rostrum brown; palpi black. Antennæ broken. Front and anterior vertex darkened, pruinose; occiput yellow.

Thorax uniformly pale whitish or pinkish white. Halteres with stem pale, knob broken. Legs with all coxæ and trochanters pale yellow; fore and middle femora black, remainder of

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[3] Philip. Journ. Sci. 56 (1935) 358, 359.

legs white, only terminal tarsal segments a trifle infumed. Wings (Plate 1, fig. 10) hyaline, unmarked except for slightly infuscated origin of Rs and cord, remaining veins pale yellow. Venation: Sc_2 a distance before origin of Rs about equal to three times its own length; Rs long, arcuated at origin, subequal to vein R; R_2 transverse, longer than R_{1+2}; R_{2+3+4} about twice basal section of R_5; outer medial forks relatively deep; m-cu about one-third its length beyond fork of M.

Abdomen broken.

Habitat.—China (Szechwan).

Holotype, Sex?, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*).

Dicranota (*Amalopina*) *hyalipennis* is readily separated from all previously described members of the *elegantula* group by the nearly hyaline wings, with distinct venational details. The known species of this group may be separated as follows:

Key to the known species of the elegantula group.

1. Mesonotum distinctly patterned, with a dark median præscutal stripe and paired dark stripes from suture caudad, leaving centers of scutum, scutellum, and mediotergite pale .... 2.

Mesonotum uniformly pale. .... 4.

2. Wings nearly clear (Eastern Himalayas to Malay Peninsula).
D. (*A.*) *elegantula* (Brunetti).

Wings distinctly patterned with brown, including a marginal series of spots at ends of longitudinal veins. (*gibbera* group) .... 3.

3. Wings (male) broad, widest opposite end of vein 2d A (Japan).
D. (*A.*) *gibbera gibbera* (Alexander).

Wings (male) narrow, of approximately equal width along central third of wing (northern Japan).
D. (*A.*) *gibbera karafutonis* (Alexander).

4. Wing markings greatly reduced, restricted to veins comprising origin of Rs and cord; Rs subequal to vein R before Sc_2 (western China).
D. (*A.*) *hyalipennis* sp. nov.

Wings with a large darkened area at cord, reaching costa anteriorly; all longitudinal veins with small darkened marginal spots; Rs nearly twice as long as vein R before Sc_2 (western China).
D. (*A.*) *megaplagiata* Alexander.

All species of the *elegantula* group have the legs pale with exception of the femora of the fore and middle legs, which are abruptly and uniformly blackened.

HEXATOMINI

OXYDISCUS (OXYDISCUS) REDUCTUS sp. nov. Plate 1, fig. 11; Plate 2, fig. 32.

General coloration of mesonotum and pleural almost uniformly dark brown; halteres infuscated; femora yellow, tips abruptly blackened; wings weakly infuscated, prearcular and broad costal portion light cream-yellow; a restricted but clearly defined brown pattern; macrotrichia of cells reduced in number; R_2 some distance before fork of R_{3+4}; cell M_1 present, about one-half its petiole; m-cu at near midlength of cell 1st M_2; male hypopygium with styli terminal in position.

Male.—Length, about 4.5 millimeters; wing, 5.

Rostrum testaceous yellow; palpi black. Antennæ brownish black throughout, 16-segmented; beyond basal three or four, flagellar segments becoming elongate, almost setaceous; verticils exceeding segments in length. Head brown.

Mesonotum almost uniformly dark brown, surface polished, lateral portions of præscutum and scutum a little paler. Pleura almost uniformly dark brown. Halteres infuscated, base of stem narrowly yellow. Legs with coxæ yellowish testaceous; trochanters yellow; femora yellow, tips rather narrowly and abruptly blackened, amount subequal on all legs; tibiæ and basitarsi yellow, extreme tips very narrowly and insensibly darkened; outer tarsal segments infuscated. Wings (Plate 1, fig. 11) with ground color weakly infuscated, prearcular and broad costal portions light cream-yellow; anal cells a little paler than ground; a restricted but very distinct brown pattern, arranged as follows: Arculus, origin of Rs, stigma, cord, outer end of cell 1st M_2 and fork of R_{3+4}; veins pale brown, more flavous in brightened areas. Wings widened opposite termination of vein 2d A, this presumably a sexual character. Macrotrichia of cells reduced in number when compared with *issikina*, restricted to outer portions of outer radial and medial cells and in the stigmal darkening (shown in figure by stippling). Venation: Sc_1 ending shortly before fork of Rs, Sc_2 slightly removed from its tip; Rs weakly angulated at origin; R_2 some distance before fork of R_{3+4}; cell M_1 about one-half its petiole; m-cu at near midlength of cell 1st M_2; vein and cell 2d A elongate (at least in male).

Abdomen dark brown, lateral borders narrowly more blackened; hypopygium dark. Male hypopygium (Plate 2, fig. 32) with styli terminal, basistyle not produced at apex. Outer dististyle, *od*, uniformly blackened, apex unequally bispinous, lower spine longer and more curved; on mesal margin before apex with a broadly triangular point.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude 2,800 feet, June 11, 1937 (*Tsen*).

Oxydiscus (Oxydiscus) reductus is most nearly allied to *O. (O.) issikina* (Alexander), of Formosa, which, while generally similar in coloration, has the macrotrichia of the wing cells much more extensive, including the cells beyond the cord and involving the outer end of cell R. It should be noted here that the name *Adelphomyia* as formerly interpreted will have to be replaced by *Oxydiscus* de Meijere. Edwards has examined the holotype specimen of the genotype of *Adelphomyia*, *A. helvetica* Bergroth, and finds it to be a synonym of *Limnophila punctum* (Meigen). As a consequence, *Tricholimnophila* Alexander will fall as a synonym of *Adelphomyia* Bergroth (in the genus *Limnophila* Macquart) while *Oxydiscus* will become the valid name for the group under consideration.

EPIPHRAGMA (EPIPHRAGMA) SULTANA sp. nov. Plate 1, fig. 12; Plate 2, fig. 33.

General coloration grayish pruinose; antennæ (male) relatively elongate; basal two flagellar segments fused, orange, remaining segments black; halteres long, pale brown; femora chiefly blackened, bases narrowly yellow; a narrow yellow subterminal ring; tibiæ and tarsi darkened; stigma darkened; basal abdominal tergites reddish brown, trivittate with darker, outer segments and hypopygium more uniformly darkened; male hypopygium with interbase elongate.

Male.—Length, 11 to 12 millimeters; wing, 12 to 13; antennæ, 3.9 to 4.

Female.—Length, about 11.5 to 13 millimeters; wing, 12 to 13.

Rostrum grayish black; palpi black. Antennæ (male) relatively elongate, as shown by measurements; scape and pedicel black; basal flagellar segment orange, succeeding segments black; flagellar segments cylindrical, with verticils that are shorter than the segments; basal flagellar segment evidently resulting from the partial fusion of two segments, the antennæ being 15-segmented; terminal segment about one-half as long as penultimate. Head dark gray, center of vertex and occiput more reddish, more or less variegated with brown.

Mesonotum chiefly gray to yellowish gray pruinose, variegated with brown, including humeral region, lateral præscutal border and four narrow stripes on posterior third of præscutum; scutal lobes darkened. Pleura gray, variegated with more blackish areas, including an irregular longitudinal stripe and the ventral sternopleurite. Halteres relatively elongate, pale brown. Legs with coxæ brownish yellow; trochanters obscure yellow; femora chiefly blackened, bases narrowly yellow, with a narrow yellow subterminal ring; extreme femoral tips more or less brightened; remainder of legs dark brown to brownish black, tarsi more or less brightened by yellow pubescence. Wings (Plate 1, fig. 12) with ground color pale yellow, variegated by the usual pale-brown pattern of the genus, dark areas narrowly bordered by still darker brown; pattern intricate, with all markings more or less interconnected; stigma solidly dark brown, occupying both sides of vein R_2; veins brownish yellow, darker in the patterned areas. Venation: Supernumerary crossvein in cell C transverse; R_{2+3+4} subequal to or a little longer than R_{2+3}; cell 1st M_2 large, with m-cu shortly before midlength.

Basal abdominal tergites reddish brown, trivittate with darker, on outer segments ground color more uniformly darkened; caudal borders of segments narrowly light gray; hypopygium yellow; basal sternites more uniformly yellow, narrowly bordered posteriorly with gray, outer sternites more uniformly pruinose; hypopygium black. Male hypopygium (Plate 2, fig. 33) with the interbase, *i*, very long and slender, exceeding length of basistyle.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotype, female, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*). Paratopotypes, males and females, with the types, June 5 and 12, 1937.

Epiphragma (*Epiphragma*) *sultana* may be told from other regional species of the genus by the leg pattern, the yellowish ground color of the wings, and by the elongate antennæ and halteres.

LIMNOPHILA (PRIONOLABIS) CARBONIS sp. nov. Plate 1, fig. 13; Plate 2, fig. 34.

General coloration polished black; halteres yellow; legs obscure yellow, femoral tips broadly, tibial apices more narrowly, darker; wings grayish subhyaline, patterned with brown; cell M_1 lacking; m-cu oblique, at near one-third length of cell 1st M_2; male hypopygium with tergite deeply emarginate; both dististyles simple.

Male.—Length, about 6.5 millimeters; wing, 7.8.

Rostrum and palpi black. Antennæ 16-segmented brownish black; flagellar segments oval; verticils subequal in length to the segments. Head black.

Thorax uniformly black. Halteres relatively long, pale yellow throughout. Legs with coxæ and trochanters black; femora obscure yellow, tips broadly darker, the amount subequal on all legs; tibiæ and basitarsi pale, tips narrowly darkened; remaining tarsi dark brown. Wings (Plate 1, fig. 13) grayish subhyaline, patterned with brown, including cell C, intermediate portion of cell Sc, a broad seam along vein Cu, seams along cord and outer end of cell 1st M_2, a spot at origin of Rs, and stigma; broad, vaguer seams along veins beyond cord; prearcular field more yellow; veins pale brown, a trifle darker in clouded areas; veins of prearcular field and vein M light yellow. Venation: Sc_1 ending nearly opposite fork of R_{2+3+4}, Sc_2 near its tip, about opposite fork of Rs; R_{2+3+4} short, less than R_2; cell M_1 lacking; m-cu oblique, at near one-third length of cell 1st M_2.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 34) with caudal margin of tergite, *9t*, deeply and narrowly emarginate, lobes slender, densely setuliferous. Outer dististyle, *od*, with a large subglobular fleshy lobe at base, sclerotized portion simple, narrowed to a gently curved apex, surface with coarse setæ. Inner dististyle, *id*, simple. Gonapophyses, *g*, appearing as slender pale blades, tips curved, apices obtusely rounded.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, summit, altitude 11,000 feet, June 9, 1937 (*Tsen*).

Limnophila (*Prionolabis*) *carbonis* is quite distinct from the other regional species of the subgenus that have the body coloration polished black and cell M_1 lacking. The heavily patterned wings and structure of the male hypopygium provide excellent specific characters.

ELEPHANTOMYIA (ELEPHANTOMYIA) CARBO sp. nov. Plate 1, fig. 14; Plate 2, fig. 35.

General coloration black, including thorax and abdomen; head dark gray; halteres pale yellow; legs black, femoral bases broadly yellow, tarsi paling to yellow; wings yellow, heavily patterned with brown, including a broad seam at cord.

Male.—Length, excluding rostrum, 6.5 to 8 millimeters; wing, 8 to 9.5; rostrum, 5 to 6.2.

Rostrum only a little shorter than remainder of body, black throughout, including palpi. Antennæ black, scape slightly pruinose, pedicel reddish brown; basal two flagellar segments fused, there being twelve subcylindrical segments beyond fusion segment; outer flagellar segments with long conspicuous verticils. Head dark gray; anterior vertex relatively narrow, about as wide as diameter of scape.

Thorax uniformly black, surface subnitidous. Halteres uniformly pale yellow. Legs with coxæ black; trochanters obscure yellow; femora black, bases conspicuously yellow, narrowest (about proximal sixth) on forelegs, broadest on posterior legs (about proximal fourth); tibiæ black; proximal portion of basitarsi brownish black, remainder of tarsi paling to obscure yellow. Wings (Plate 1, fig. 14) with ground color yellow, prearcular cells brighter yellow; a rather heavy brown pattern, including cell C; stigma; broad seams along cord and outer end of cell 1st M_2; a broad seam along vein Cu, on proximal portion involving cell Cu, on distal two-thirds involving cell M; posterior wing margin, from tip back to axilla darkened; cells beyond cord somewhat darker than those in basal portion of wing, especially in paratype; veins brown, M chiefly yellow; prearcular veins bright yellow. Venation: Sc_1 ending shortly beyond fork of Rs, Sc_2 at its tip; branches of Rs generally parallel throughout their length, cell R_2 thus wider than R_3; upper branch of sector more or less sinuous, especially in paratype; cell 1st M_2 large, rectangular, m-cu at near one-third to one-fourth the length.

Abdomen, including hypopygium, black. Male hypopygium (Plate 2, fig. 35) with mesal face of basistyle with abundant setæ. Outer dististyle slender, sinuous, at apex with two unequal teeth, the larger tooth strongly decurved. Penefilum, *pf*, conspicuous.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Paratopotype, male.

Elephantomyia (Elephantomyia) carbo is entirely different from the other described Asiatic species of the genus. The intense black color of the thorax and abdomen, in conjunction with the heavily patterned wings, readily distinguishes the species.

ERIOPTERINI

CRYPTERIA LUTEIPENNIS sp. nov. Plate 1, fig. 15; Plate 2, fig. 36.

General coloration clear gray; fusion segment of flagellum elongate, about equal in length to the succeeding five segments taken together and evidently formed by fusion of five segments; halteres yellow; legs light brown to brownish yellow, outer tarsal segments brownish black to black; wings narrow, tinged with pale yellow; cell 1st M_2 narrow, its greatest width about one-half the length; m-cu close to or before fork of M; vein 2d

A relatively short, ending some distance before level of m-cu; male hypopygium with inner dististyle much compressed, flattened.

Male.—Length, 5 to 5.5 millimeters; wing, 5.5 to 6.

Female.—Length, 6 to 6.5 millimeters; wing, 6 to 6.5.

Rostrum and palpi black. Antennæ black throughout; nine flagellar segments beyond elongate fusion segment which thus evidently comprises five segments and is about equal in length to the succeeding five segments combined; verticils subequal in length to segments, verticils of fusion segment sparse. Head light gray; eyes small; vertex broad.

Thorax clear light gray, without evident stripes or other markings. Halteres yellow. Legs with coxæ gray; trochanters light brown; remainder of legs light brown to brownish yellow, tibiæ and tarsi brownish black to black. Wings (Plate 1, fig. 15) narrow, with a uniform pale-yellow tinge, costal region more saturated; veins yellow. Venation: Vein R_{2+3} running close to R_1, narrowing distal third of cell R_1; vein R_2 lacking; cell 1st M_2 narrow, its greatest width about one-half its length; petiole of cell M_1 variable, from one and one-half to two times m; m-cu close to or a short distance before fork of M; vein 2d A relatively short, ending some distance before level of m-cu, cell narrow.

Abdominal tergites brownish black, sternites brown, their caudal margins darker; hypopygium black. Male hypopygium (Plate 3, fig. 36) with basistyle, *b*, elongate; mesal face on basal half slightly expanded, provided with a slender hair pencil. Outer dististyle, *od*, slender, simple, apex acute; before apex on distal fourth with a series of microscopic appressed teeth. Inner dististyle, *id*, broadly compressed, extensive. Gonapophyses, *g*, appearing as slightly curved blackened spines. Ovipositor with cerci elongate, horn-yellow.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, several of both sexes.

Crypteria luteipennis is closest to *C. claripennis* (Brunetti), of the eastern Himalayas.[4] The type of *claripennis* was examined by Edwards who describes it as being very close to, if not identical with, the genotype of *Crypteria limnophiloides* Bergroth,

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[4] Rec. Indian Mus. 8 (1913) 153, 154; 15 (1918) 324, fig. d (venation); 26 (1924) 302.

of northern Europe. Compared with the present fly, this latter species has the hypopygium quite different, and further has the fusion segment of the antennal flagellum much shorter, a little longer than the succeeding three flagellar segments combined.

GONOMYIA (LIPOPHLEPS) PARVISPINOSA sp. nov. Plate 1, fig. 16; Plate 3, fig. 37.

General coloration brownish gray, variegated with yellow, including a well-defined pleural stripe; legs black; wings pale brown, variegated with yellow; Sc_1 ending some distance before origin of Rs; abdominal segments dark brown, caudal borders conspicuously yellow; male hypopygium with outer dististyle a gently curved black rod, outer margin with microscopic appressed teeth, at base of style with a small black spine directed distad.

Male.—Length, about 3 millimeters; wing, 3.5.

Rostrum yellow; palpi black. Antennæ with scape and unusually large pedicel yellow above, darker beneath; flagellum black; verticils of basal flagellar segments unusually long. Head large, yellow, with a grayish trilobed area in center of vertex; occiput darkened.

Pronotum and broad lateral pretergites light sulphur yellow. Mesonotal præscutum, scutum, and base of scutellum dark brownish gray, posterior border of scutellum obscure yellow; mediotergite dark, with a transverse V-shaped yellow marking at near midlength. Pleura dark brownish gray, with a conspicuous pale yellow longitudinal stripe extending from and including fore coxæ, passing beneath root of halteres to abdomen; dorsopleural membrane more or less yellow. Halteres yellow, base of knob a trifle obscured. Legs with coxæ pale, fore coxæ light yellow, as described; trochanters testaceous; remainder of legs black, femoral bases restrictedly paler. Wings (Plate I, fig. 16) variegated pale brown and pale yellow, the latter including cells C and Sc, together with areas before and beyond brown stigma; subhyaline areas in cells before and beyond cord; veins brown, brightened in yellow areas. Venation: Sc short, Sc_1 ending some distance before origin of Rs, Sc_2 close to its tip; m-cu shortly before fork of M.

Abdominal segments bicolored, dark brown, caudal borders conspicuously yellow, more obscure on sternites. Male hypopygium (Plate 3, fig. 37) with outer dististyle, *od*, a gently curved black rod, outer margin with microscopic appressed teeth; at base a small, gently curved black spine, directed outward or distad. Inner dististyle, *id*, with spine relatively long and slender, exceeding height of style itself. Phallosome not evident in the only available hypopygium.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude 2,800 feet, June 11, 1937 (*Tsen*). Paratopotype, 1 broken male.

In the general structure of the male hypopygium the present fly is closest to *Gonomyia* (*Lipophleps*) *luteimarginata* Alexander and *G.* (*L.*) *flavocostalis* Alexander. In the former species the basal spine of the outer dististyle is not directed outwardly but is recurved basad, while the structure of the inner style is quite distinct; in *flavocostalis* the details of structure of both dististyles are entirely distinct, while the legs are not uniformly darkened, the femora being narrowly ringed with brown before apex.

GONOMYIA (GONOMYIA) PRINCIPALIS sp. nov. Plate 1, fig. 17; Plate 3, fig. 35.

Large (wing, male, over 6 millimeters); general coloration yellow and black; rostrum orange; antennæ black throughout; scutellum yellow; dorsal pleura with an incomplete dark stripe on propleura and anepisternum; halteres pale yellow; wings strongly tinged with brownish yellow; Sc long, m-cu a short distance beyond fork of M; male hypopygium with both dististyles bifid; phallosome complex, with two blackened apophyses.

Male.—Length, about 5.5 millimeters; wing, 6.5 to 6.8.

Female.—Length, about 6.5 millimeters; wing, 7.

Rostrum orange; palpi black. Antennæ black, relatively long, if bent backward extending to wing root or shortly beyond; flagellar segments elongate. Front orange; posterior portion of head dark gray.

Pronotum and lateral pretergites light sulphur yellow. Mesonotal præscutum with disc dull blackish gray, humeral region yellow, the broad lateral margins more obscure yellow; scutal lobes blackish gray, median area restrictedly obscure yellow; scutellum chiefly yellow, parascutella dark; mediotergite dark, sparsely pruinose, cephalic-lateral portions light yellow. Pleura yellow, with a narrow, abbreviated, dark-brown, longitudinal stripe extending from cervical region across ventral propleura and anepisternum; pteropleurite and pleurotergite yellow; ventral sternopleurite and meron more reddish brown. Halteres pale yellow. Legs with coxæ and trochanters yellow; remainder of legs brown, terminal tarsal segments darker. Wings (Plate I, fig. 17) with a strong brownish yellow tinge, prearcular field and costal border clear light yellow; less distinct yellow borders to veins, broadest and most conspicuous along veins Cu and 2d A; stigma scarcely differentiated against ground; veins light brown, yellow in luteous areas. Venation: Sc relatively long, Sc$_1$ ending opposite one-third to nearly midlength of Rs, Sc$_2$ near tip; basal section of R$_5$ short to obliterated, longer in female; veins R$_3$ and R$_4$ strongly divergent, cell R$_3$ at margin thus very wide; m-cu a short distance beyond fork of M.

Abdominal tergites dark brown, lateral borders broadly yellow, caudal margins very narrowly and inconspicuously so; sternites reddish yellow, caudal margins yellow; hypopygium yellow. Male hypopygium (Plate 3, fig. 38) with apical lobe of basistyle, *b*, relatively stout, about one-half as long as style. Outer dististyle, *od*, conspicuously bifid, the longer outer arm with numerous setæ; inner arm dilated into a dark blade. Inner dististyle, *id*, bearing a long basal arm that is nearly as long as outer style; at near midlength split into two long, acute, appressed spines. Phallosome, *p*, complex, as shown by figure, with two blackened apophyses, one strongly sinuous; apex of ædeagus a long straight spine.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, White Cloud Temple, altitude 9,000 feet, June 5, 1937 (*Tsen*). Allotopotype, female, June 12, 1937. Paratopotypes, 2 males, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*).

Gonomyia (*Gonomyia*) *principalis* is readily told from all other regional species by the large size and by the structure of the male hypopygium.

GONOMYIA (IDIOCERA) INSIDIOSA sp. nov. Plate 1, fig. 16; Plate 3, fig. 39.

General coloration gray, præscutum with two intermediate brown stripes; pseudosutural foveæ black; antennæ black, pedicel yellow; pleura with a pale-yellow longitudinal stripe; halteres infuscated; legs brown; wings pale yellow, restrictedly patterned with brown; stigma dark brown; Sc$_1$ ending about opposite one-third length of Rs, Sc$_2$ before origin of Rs; veins R$_{1+2}$ and R$_3$ close together at margin; m-cu about one and one-half times its length before fork of M; male hypopygium with three dististyles, intermediate one bifid, the two arms very unequal; inner dististyle simple; ædeagus a slender rod with slightly decurved apex.

Male.—Length, about 4.5 millimeters; wing, 5.

Rostrum and palpi black. Antennæ with scape dusky above, yellow beneath; pedicel yellow; flagellum uniformly black; flagellum 13-segmented, basal segment short-oval, outer segments more elongate. Head light gray, paler in front; anterior vertex with a dusky central spot.

Pronotum darkened medially, pale yellow on sides. Mesonotal præscutum gray, with two intermediate brown stripes, poorly indicated in front, more divergent and well-defined behind; pseudosutural foveæ black, conspicuous; scutum gray, centers of lobes darker; scutellum dull orange, restrictedly darker at base; postnotum gray. Pleura dark gray with a pale-yellow longitudinal stripe, extending from behind fore coxæ, widened behind. Halteres infuscated, base of stem restrictedly yellow. Legs with fore coxæ blackened, remaining coxæ paler, more or less variegated with yellow; trochanters yellow, fore pair darker; remaining legs brown, outer segments darker. Wings (Plate 1, fig. 18) with a pale-yellow tinge, costal border a little more saturated; stigma short-oval, dark brown, conspicuous; cord and m-cu narrowly dark brown, produced by a darkening of the veins only; veins chiefly pale, outer medial branches a little darker. Venation: Sc relatively short, Sc_1 ending about opposite one-third length of Rs, Sc_2 far from its tip, a short distance before origin of Rs; R_3 nearly erect, close to R_{1+2} at margin; vein R_4 long, gently curved; cell 2d M_2 longer than its petiole; m-cu about one and one-half times its length before fork of M.

Abdominal tergites dark brown, extreme caudal margins of individual segments yellow; basal sternites a little paler in central portions; hypopygium brown. Male hypopygium (Plate 3, fig. 39) with ventral lobe of basistyle, *b*, moderately produced, obtuse at apex. Three dististyles, the intermediate, *md*, bifid; outer style, *od*, broad at base, gradually narrowed to an acute black spinous apex, immediately before tip with three or four long setæ; intermediate style, *md*, with outer arm about four times as long as spurlike inner arm; inner style, *id*, a small simple rod, with three or four setæ along length, with other smaller setæ at apex. Ædeagus, *a*, a slender straight rod, extreme tip decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude about 2,800 feet, June 11, 1937 (*Tsen*).

Gonomyia (*Idiocera*) *insidiosa* is very different from all described species, the relatively simple structure of the dististyles being diagnostic. In this regard, it comes closest to the otherwise entirely different *G.* (*I.*) *reticulata* Alexander.

GONOMYIA (IDIOCERA) OCTAVIA sp. nov. Plate 1, fig. 19; Plate 3, fig. 40.

General coloration light gray; antennæ with scape and pedicel white, flagellum black; halteres infuscated; legs pale brownish yellow; wings yellowish subhyaline, restrictedly patterned with dark brown, including small stigma and dark seams at origin of Rs and along cord; Sc short, Sc_1 ending a little beyond origin of Rs, Sc_2 far from its tip; R_3 nearly perpendicular, R_4 strongly arcuated; m-cu about its own length before fork of M; male hypopygium with four dististyles on either side, three slender and simple, the fourth widely expanded into a flattened scoop; ædeagus with extreme tip decurved.

Male.—Length, about 4.5 millimeters; wing, 5.2.

Rostrum brownish black, palpi black. Antennæ with scape and pedicel white, flagellum black; flagellar segments oval, verticils exceeding segments in length. Head gray, front yellow.

Pronotum and lateral pretergites yellow. Mesonotum light gray, præscutum with four very scarcely darker, poorly indicated brown stripes, laterals even less distinct; pseudosutural foveæ pale; humeral and lateral portions of præscutum obscure yellow; posterior margin of scutellum and extreme lateral margins of mediotergite obscure yellow. Pleura chiefly obscure yellow, dorsopleural region darker. Halteres infuscated. Legs with coxæ and trochanters pale; remainder of legs pale brownish yellow, terminal tarsal segments darker. Wings (Plate 1, fig. 19) yellowish subhyaline, restrictedly patterned with dark brown, including the small, short-oval stigma and narrow seams at origin of Rs, along cord and on m-cu, the latter best shown by the darkened veins; remaining veins chiefly yellow. Venation: Sc short, Sc_1 ending just beyond origin of Rs, Sc_2 far from its tip; Rs long, arcuated; vein R_3 nearly perpendicular, without trichia; distance on costa between tips of veins R_{1+2} and R_3 about one-half length of latter; vein R_4 strongly arcuated, with trichia throughout its length; cell 2d M_2 subequal to its petiole; m-cu about its own length before fork of M.

Abdominal tergites dark brown, sternites and hypopygium paler. Male hypopygium (Plate 3, fig. 40) with four dististyles or primary branches thereof; longest style, *md*, appearing as a flattened scooplike blade that is extended into a long straight spinous point, on inner margin of blade with a blackened fingerlike lobe; other dististyles all subequal in length, slender and simple, the outermost, *od*, glabrous, curved at apex into an acute blackened point; intermediate style glabrous, most slender; innermost style simple, with scattered setæ, the tip an acute spine. Ædeagus, *a*, weakly constricted at near midlength, extreme tip decurved.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude about 2,800 feet, June 11, 1937 (*Tsen*).

The nearest ally is *Gonomyia* (*Idiocera*) *shantungensis* Alexander, which differs very conspicuously in the structure of the male hypopygium and in the details of wing pattern and venation.

CRYPTOLABIS (DÆOURA) PERDUCTILIS sp. nov. Plate 1, fig. 20; Plate 3, fig. 41.

General coloration of thorax dark brown; wings light gray, costal border and prearcular region conspicuously whitened; male hypopygium with dististyle exceedingly long and slender, before basal third bearing a flattened, paddlelike, lateral blade; ædeagus long and setoid in appearance.

Male.—Length, about 4 millimeters; wing, 4.3 to 4.4.

Rostrum brown; palpi brownish black. Antennæ brownish black. Head dark brown.

Thoracic dorsum almost uniformly dark brown, præscutum unstriped; scutellum not or scarcely brightened. Pleura dark. Halteres dusky, stem a little paler. Legs with coxæ and trochanters yellow; remainder of legs chiefly pale brown, inconspicuously hairy. Wings (Plate 1, fig. 20) light gray, costal border and prearcular region conspicuously whitened; a more or less distinct darker area crossing wing at cord; veins pale brown, light yellow in the white areas. Venation: R_{2+3+4} a trifle longer than R_{2+3} or R_2; m-cu before midlength of M_{3+4}; vein 2d A sinuous on distal third.

Abdomen brown, hypopygium more yellowish. Male hypopygium (Plate 3, fig. 41) with dististyle, *d*, exceedingly long and slender, sinuous, gradually narrowed to a needlelike point, just before basal third bearing a flattened, paddlelike, lateral blade. Arms of tergite, *9t*, appearing as glabrous flattened blades. Ædeagus, *a*, with basal portion slightly dilated, apical portion long-produced, unusually slender.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Flying Bridges Temple, altitude about 2,800 feet, June 4, 1937 (*Tsen*). Paratopotype, male, June 11, 1937.

Cryptolabis (Bæoura) perductilis is entirely different from all species hitherto made known. In the produced dististyle and ædeagus it is closest to *C. (B.) dicladura* Alexander, of Hainan, yet quite distinct.

ORMOSIA BEATIFICA sp. nov. Plate 1, fig. 21.

General coloration dark brown; antennal flagellum black; halteres and legs uniformly light yellow; wings light yellow, heavily and handsomely patterned with brown, including seams along cord, M_3, and Cu; outer radial field faintly infumed.

Female.—Length, about 5.5 millimeters; wing, 6.

Rostrum brown; palpi brownish black. Antennæ with scape and pedicel dark brown; flagellum black; flagellar segments long-oval, verticils of basal segments elongate. Head brown.

Thorax almost uniformly dark brown, with conspicuous yellow vestiture. Halteres uniformly pale yellow. Legs with coxæ brown; trochanters obscure yellow; remainder of legs uniformly light yellow. Wings (Plate 1, fig. 21) light yellow, heavily and very handsomely patterned with brown; prearcular and costal fields more saturated yellow; stigma large, dark brown; smaller brown spots at origin of Rs, Sc_2, and tips of all longitudinal veins; broad paler brown washes along cord and as seams the entire length of veins M_3 and Cu, and on distal half of vein 2d A; entire outer radial field weakly infumed; veins yellow, darker in clouded areas. Macrotrichia of cells abundant (represented in figure by stippling). Venation: Vein R_3 rather strongly upcurved at tip; vein 2d A moderately sinuous.

Abdomen dark brown, caudal borders of sternites narrowly and inconspicuously paler.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*).

Ormosia beatifica is readily told from all regional species in the uniformly light-yellow legs and conspicuously patterned wings. It apparently belongs to the *similis* group, but this cannot be affirmed in the absence of the male sex.

ORMOSIA DEFESSA sp. nov. Plate 1, fig. 22; Plate 3, fig. 42.

Belongs to the *similis* group; general coloration gray; antennæ (male) relatively long, if bent backward extending about to middistance between roots of wings and halteres; halteres yellow; legs dark, tibiæ with yellow vestiture; wings brownish yellow, restrictedly patterned with darker; R_2 at or shortly beyond fork of R_{2+3+4}; male hypopygium with outer gonapophysis sinuous, outer margin with several teeth, surface with coarse scattered setæ; inner apophyses appearing as flattened plates, outer mesal angle produced into a spinous point.

Male.—Length, 4 to 4.3 millimeters; wing, 4.6 to 5.

Rostrum black; palpi brownish black. Antennæ black throughout, relatively long, if bent backward extending about to middistance between roots of wings and halteres; flagellar segments long-oval, with a dense white pubescence; more basal segments with unusually long verticils, at midlength of flagellum becoming much shorter, on outer segments much shorter than segments alone. Head dark gray, vestiture yellow.

Thorax gray, præscutum without clearly delimited stripes, vestiture yellow. Halteres short, pale yellow, stem short, knob large. Legs with coxæ dark; trochanters obscure yellow; femora dark brown; tibiæ brighter, color produced by yellow pubescence; tarsi dark brown. Wings (Plate 1, fig. 22) tinged with brownish yellow, restrictedly patterned with darker, including stigma, a seam along cord and a darkened area at fork of M_{1+2}; veins yellow, darker in clouded areas; macrotrichia of cells (indicated in figure by stippling) chiefly yellow, darker in clouded areas. Venation: R_2 at or shortly beyond fork of R_{2+3+4}, in latter case R_{2+3} thus very short; outer radial branches only slightly upcurved at tips; m-cu at fork of M.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 3, fig. 42) with outer dististyle, *od*, flattened, squamulose, as in the group. Gonapophyses heavily blackened, outer pair, *og*, slender, sinuous, outer margin with a series of more than a dozen small teeth, with a few more obtuse teeth on inner margin near apex; surface of apophysis with abundant long setæ; inner apophyses, *ig*, shorter, appearing as flattened plates, narrowest at base, a little expanded outwardly, outer mesal angle produced into a spinous point.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tseu*). Paratopotype, male.

Ormosia defessa is apparently closest to *O. tenuispinosa* Alexander, likewise from western China, differing especially in the shorter antennæ of the male and in the structure of the male hypopygium, notably of the gonapophyses.

ERIOPTERA (ERIOPTERA) JUVENILIS Alexander. Plate 3, fig. 43.

Erioptera (Erioptera) juvenilis ALEXANDER, Philip. Journ. Sci. 50 (1933) 157, 158.

The type, a unique female, was from the Japanese Alps, Honshiu, Japan, taken August 8, 1931, by Jiro Machida. What appears to be unquestionably the same species is from Mount Omei, western China, collected at White Cloud Temple, altitude 9,000 feet, and at the summit, altitude 11,000 feet, from June 5 to 12, 1937, by Tsen.

Male hypopygium (Plate 3, fig. 43) with outer dististyle, *od*, a simple blackened rod, gradually narrowed to acute tip. Inner dististyle, *id*, exceeding one-half length of outer, at apex with an erect or slightly recurved spine; outer margin of basal half with a low flange. Gonapophyses, *g*, appearing as smooth blackened incurved horns, on inner margin of basal half produced into an acute spine.

Allotype, male, Mount Omei, Szechwan, White Cloud Temple, altitude 9,000 feet, June 12, 1937 (*Tsen*).

ERIOPTERA (ILISIA) DICHROA sp. nov. Plate 1, fig. 23; Plate 3, fig. 44.

General coloration gray; basal segments of antennæ yellow; halteres pale yellow throughout; femora brown, tips darker brown; remainder of legs dark brown; wings bicolored, yellow, stigma, veins beyond cord, and a conspicuous seam on vein Cu brown; cell 1st M_2 closed; abdomen, including hypopygium, black; male hypopygium with both gonapophyses slender and of nearly equal diameter, outer pair appearing as slender black spines.

Male.—Length, 4.7 to 5 millimeters; wing, 5.6 to 6.

Rostrum dark gray; palpi black. Antennæ with scape dark brown; pedicel light brown; basal flagellar segments yellow, outer segments infuscated. Head gray.

Pronotum obscure yellow. Mesonotum almost uniformly clear gray; præscutal stripes not or scarcely darker; mesal edges of disc of scutal lobes a little darker; scutellum more blackened. Pleura gray. Halteres pale yellow throughout. Legs with fore coxæ dark brown, remaining coxæ paler, especially posterior pair; trochanters obscure yellow; femora brown, tips darker brown; remainder of legs dark brown. Wings (Plate 1, fig. 23) clear light yellow, including veins; stigma, a seam along vein Cu, cord, and most of veins beyond latter brown, producing a bicolored appearance; central portions of outer radial veins, vein M_{3+4} and basal portion of vein M_4 yellow. Venation: Cell 1st M_2 larger than in *postrema*, M_4 being less than twice length of M_{3+4}.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 3, fig. 44) with outer arm of outer dististyle, *od*, relatively short and stout, coarsely toothed; inner arm relatively stout. Outer gonapophyses, *g*, appearing as slender black spines; inner apophyses slender, their thickness subequal to diameter of base of spine of outer apophyses, yellow throughout, distal fourth with delicate setulæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*). Paratopotype, male.

The nearest ally is *Erioptera* (*Ilisia*) *postrema* Alexander, which is readily told by the unicolorous wings and by the structure of the male hypopygium, as discussed elsewhere in this report.

ERIOPTERA (ILISIA) POSTREMA Alexander. Plate 3, fig. 45.

Erioptera (*Ilisia*) *postrema* ALEXANDER, Philip. Journ. Sci. 60 (1936) 350, 351.

The type was a unique female from Mount Omei. I now possess four further specimens, including the male sex, likewise from White Cloud Temple, Mount Omei, altitude 9,000 feet, taken June 12, 1937, by Mr. Tsen Bao-chi.

The male is quite like the female in all details of coloration. Male hypopygium (Plate 3, fig. 45) when compared with that of *dichroa* (Plate 3, fig. 44) shows the outer arm of the outer dististyle, *od*, slenderer, with very small inconspicuous teeth; inner arm unusually slender. Outer gonapophyses, *g*, appearing as very slender, almost setiform spines; inner apophyses much stouter, their diameter at least four times the thickness of the spine of the outer appendage, the surface with microscopic setulæ.

Male.—Length, 5 to 5.5 millimeters; wing, 5.5 to 6.5.

Allotype, male, White Cloud Temple, Mount Omei, altitude 9,000 feet, June 12, 1937 (*Tsen*).

MOLOPHILUS (MOLOPHILUS) FURIOSUS sp. nov. Plate 1, fig. 16; Plate 3, fig. 46.

Belongs to the *gracilis* group and subgroup; general coloration black, anterior lateral pretergites restrictedly yellow; antennæ short, black throughout; halteres infuscated, knobs slightly more yellowish; legs black, femoral bases restrictedly obscure yellow; wings strongly tinged with blackish, prearcular region restrictedly yellow; male hypopygium with ventral lobe of basistyle unusually large and flattened, with an acute blackened spine at base; outer dististyle a simple curved rod; inner dististyle bifid at apex.

Male.—Length, 3.8 to 4 millimeters; wing, 4.5 to 5.

Female.—Length, about 5 millimeters; wing, 5.2.

Rostrum and palpi black. Antennæ short, black throughout; flagellar segments oval. Head black.

Thorax uniformly black, surface subnitidous; anterior lateral pretergites restrictedly yellow. Halteres infuscated, knobs slightly more yellow. Legs black, femoral bases narrowly obscure yellow, most conspicuous on middle and posterior legs. Wings (Plate 1, fig. 24) relatively narrow, strongly suffused with blackish; prearcular field restrictedly yellow; veins and macrotrichia brownish black. Venation: R_2 and r-m about in transverse alignment; petiole of cell M_3 about three times m-cu; vein 2d A relatively long, ending beyond m-cu.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 46) with ventral lobe of basistyle, *vb*, unusually large and flattened, at its base with an acute blackened spine, directed mesad. Outer dististyle, *od*, a simple curved rod, tip acute. Inner dististyle, *id*, a little shorter, strongly curved, beyond midlength split into two long spines, one a little longer than the other. Ædeagus long and slender.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 6, 1937 (*Tsen*). Allotopotype, female. Paratopotypes, 5 males, June 5 and 6, 1937 (*Tsen*).

In its black coloration and, especially, the structure of the male hypopygium, the present fly is very distinct from all regional allies.

MOLOPHILUS (MOLOPHILUS) UNICLAVATUS sp. nov. Plate 3, fig. 47.

Belongs to the *gracilis* group and subgroup; general coloration dark brown; legs brown; wings subhyaline, base restrictedly more yellow; male hypopygium with a single dististyle, appearing as a powerful black rod, gently curved, at apex abruptly narrowed into a strong spine, the latter with numerous coarse setæ surrounding its base.

Male.—Length, about 2.8 millimeters; wing, 3.7.

Female.—Length, about 3.2 millimeters; wing, 3.7.

Rostrum and palpi brown. Antennæ broken. Head dark gray.

Thorax uniformly dark brown. Halteres uniformly suffused with dusky. Legs brown, trochanters a little paler. Wings subhyaline, base restrictedly more yellow; veins yellow, trichia brown. Venation: R_2 lying some distance basad of level of r-m; petiole of cell M_3 long, about three times m-cu; vein 2d A ending just before level of proximal end of m-cu.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 3, fig. 47) with ventral lobe of basistyle, *b*, produced into a long conical point, tip obtuse, with setæ to apex. A single dististyle, *d*, appearing as a powerful rod, gently curved, at apex abruptly narrowed into a strong spine, latter at base surrounded by numerous coarse black setæ; inner margin of style back from terminal spine with a linear series of strong tubercles, each tipped with a microscopic bristle. Ædeagus slender.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Chu Lao Tong Temple, altitude 6,500 feet, June 5, 1937 (*Tsen*). Allotopotype, female.

Molophilus uniclavatus is readily distinguished from all known species of the genus by the structure of the male hypopygium. The only other regional species having a single dististyle is *Molophilus trifilatus* Alexander, of Japan, which is in every other respect a very different fly.

ILLUSTRATIONS

[a, aedeagus; b, basistyle; d, dististyle; g, gonapophysis; id, inner dististyle; ig, inner gonapophysis; md, intermediate dististyle; od, outer dististyle; og, outer gonapophysis; p, phallosome; pl, penicillum; t, 9th tergite; vb, ventral lobe of basistyle; vd, ventral dististyle.]

Plate 1

Fig. 1. *Trichocera appendiculata* sp. nov., venation.
2. *Tanyptera antica* sp. nov., venation.
3. *Dictenidia glabrata* sp. nov., venation.
4. *Limonia* (*Limonia*) *perbeata* sp. nov., venation.
5. *Limonia* (*Dicranomyia*) *tseni* sp. nov., venation.
6. *Limonia* (*Dicranomyia*) *lethe* sp. nov., venation.
7. *Antocha* (*Antocha*) *flavidibasis* sp. nov., venation.
8. *Dicranota* (*Rhaphidolabis*) *præcisa* sp. nov., venation.
9. *Dicranota* (*Amalopina*) *simplex* sp. nov., venation.
10. *Dicranota* (*Amalopina*) *hyalipennis* sp. nov., venation.
11. *Oxydiscus* (*Oxydiscus*) *reductus* sp. nov., venation.
12. *Epiphragma* (*Epiphragma*) *sultana* sp. nov., venation.
13. *Limnophila* (*Prionolabis*) *carbonis* sp. nov., venation.
14. *Elephantomyia* (*Elephantomyia*) *carbo* sp. nov., venation.
15. *Crypteria luteipennis* sp. nov., venation.
16. *Gonomyia* (*Lipophleps*) *parvispinosa* sp. nov., venation.
17. *Gonomyia* (*Gonomyia*) *principalis* sp. nov., venation.
18. *Gonomyia* (*Idiocera*) *insidiosa* sp. nov., venation.
19. *Gonomyia* (*Idiocera*) *octavia* sp. nov., venation.
20. *Cryptolabis* (*Bæoura*) *perductilis* sp. nov., venation.
21. *Ormosia beatifica* sp. nov., venation.
22. *Ormosia defessa* sp. nov., venation.
23. *Erioptera* (*Ilisia*) *dichroa* sp. nov., venation.
24. *Molophilus* (*Molophilus*) *furiosus* sp. nov., venation.

Plate 2

Fig. 25. *Trichocera appendiculata* sp. nov., male hypopygium, styli.
26. *Limonia* (*Limonia*) *perbeata* sp. nov., male hypopygium.
27. *Limonia* (*Dicranomyia*) *tseni* sp. nov., male hypopygium.
28. *Limonia* (*Dicranomyia*) *lethe* sp. nov., male hypopygium.
29. *Antocha* (*Antocha*) *nebulipennis immaculata* subsp. nov., male hypopygium.
30. *Dicranota* (*Rhaphidolabis*) *præcisa* sp. nov., male hypopygium.
31. *Dicranota* (*Amalopina*) *simplex* sp. nov., male hypopygium.
32. *Oxydiscus* (*Oxydiscus*) *reductus* sp. nov., male hypopygium.
33. *Epiphragma* (*Epiphragma*) *sultana* sp. nov., male hypopygium.
34. *Limnophila* (*Prionolabis*) *carbonis* sp. nov., male hypopygium.
35. *Elephantomyia* (*Elephantomyia*) *carbo* sp. nov., male hypopygium.

PLATE 3

FIG. 36. *Crypteria luteipennis* sp. nov., male hypopygium.
37. *Gonomyia (Lipophleps) parvispinosa* sp. nov., male hypopygium.
38. *Gonomyia (Gonomyia) principalis* sp. nov., male hypopygium.
39. *Gonomyia (Idiocera) insidiosa* sp. nov., male hypopygium.
40. *Gonomyia (Idiocera) octavia* sp. nov., male hypopygium.
41. *Cryptolabis (Baeoura) perductilis* sp. nov., male hypopygium.
42. *Ormosia defessa* sp. nov., male hypopygium.
43. *Erioptera (Erioptera) juvenilis* Alexander, male hypopygium.
44. *Erioptera (Ilisia) dichroa* sp. nov., male hypopygium.
45. *Erioptera (Ilisia) postrema* Alexander, male hypopygium.
46. *Molophilus (Molophilus) furiosus* sp. nov., male hypopygium.
47. *Molophilus (Molophilus) uniclavatus* sp. nov., male hypopygium.

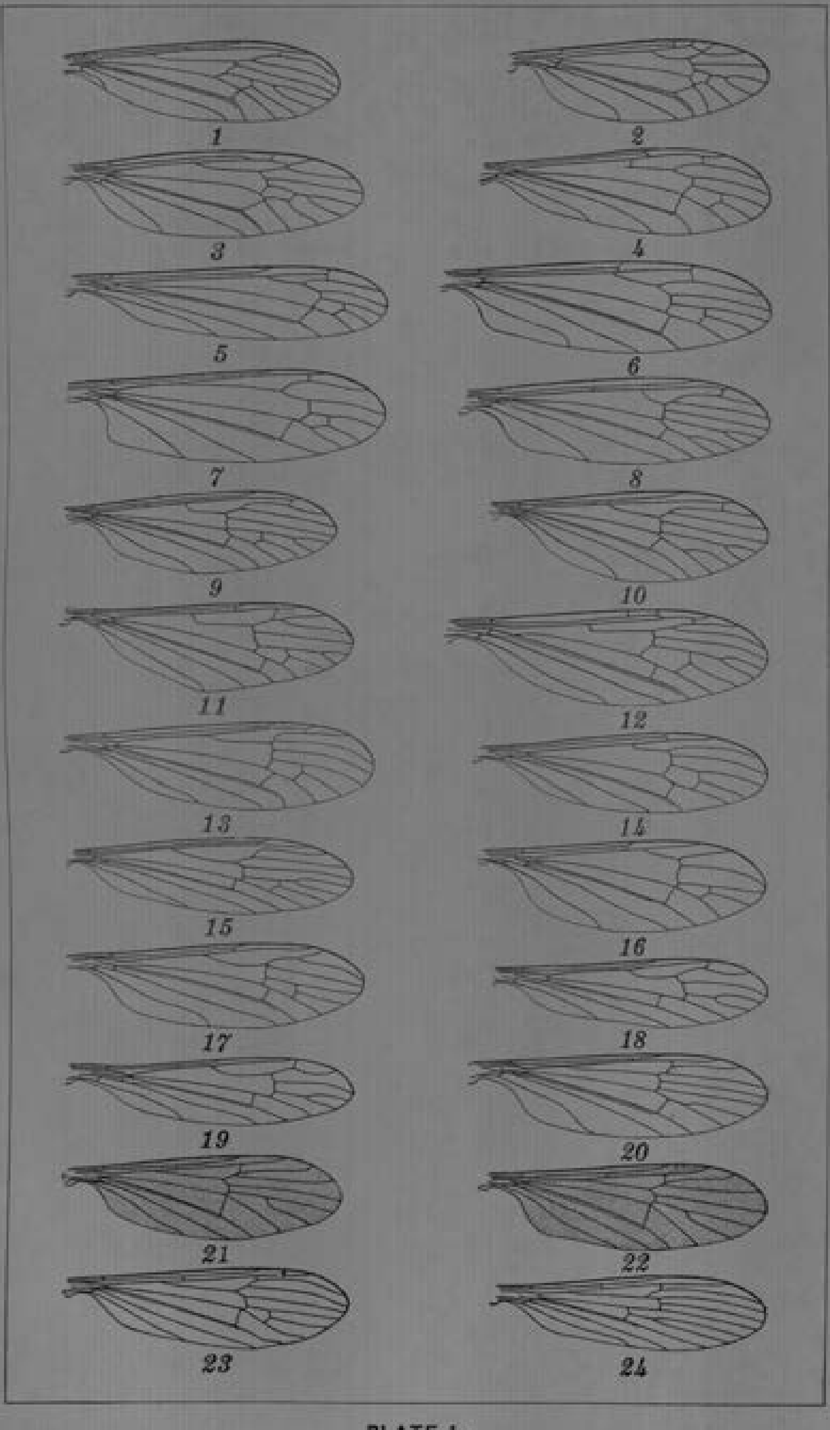
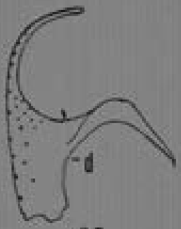


PLATE 1.



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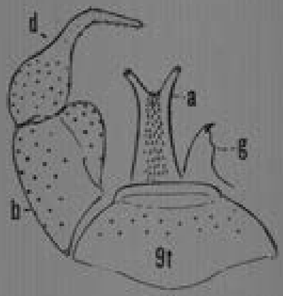

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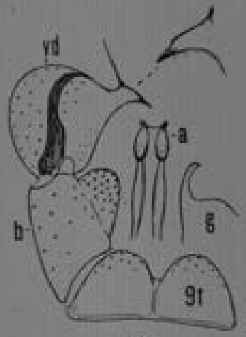

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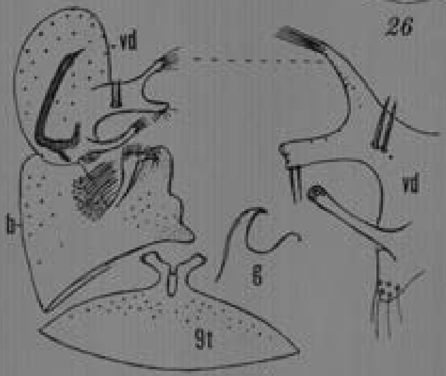

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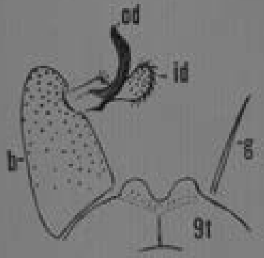

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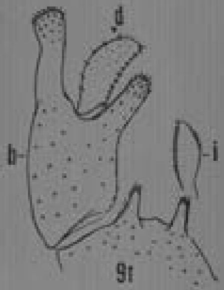

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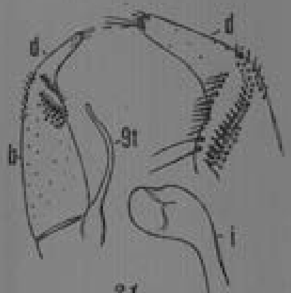

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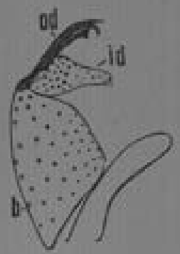

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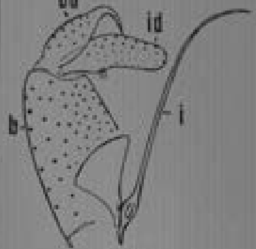

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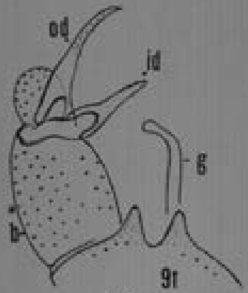

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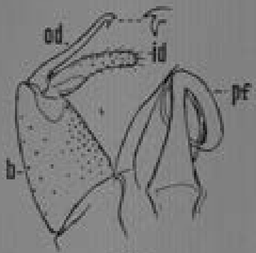

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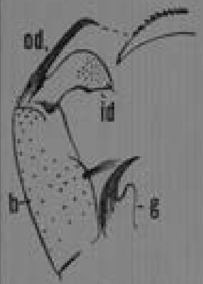
PLATE 2.



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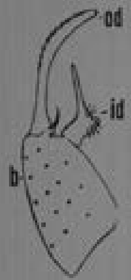

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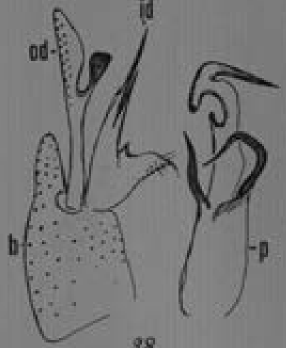

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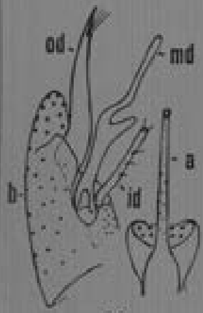

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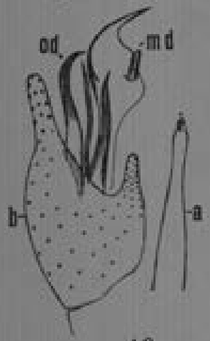

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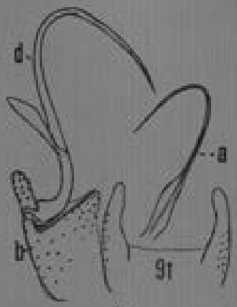

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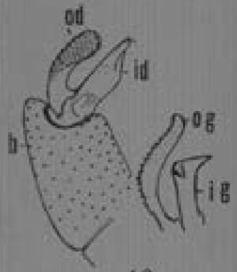

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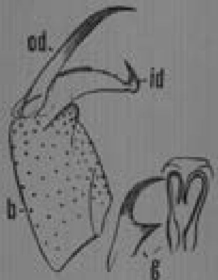

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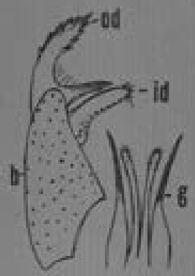

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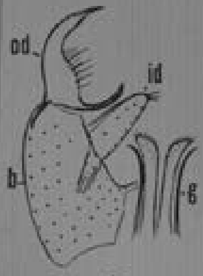

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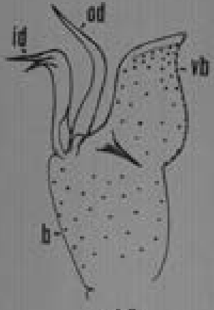

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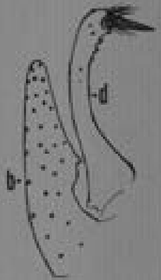

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PLATE 3.

DIATOMS FROM A MOUNTAIN BOG, KAOLINGTZE, PINCHIANG-SHENG PROVINCE, MANCHOUKUO

By B. W. Skvortzow
Of Harbin, Manchoukuo

TWO PLATES

During my last visit with Mr. P. A. Pavlov, July 15, 1926, in the mountain ranges near Kaolingtze station of the Chinese Eastern Railway, about 300 miles east from Harbin, I collected a sample of diatoms from a little mountain bog of forest mosses. In this bog the diatom flora was richly represented, quantitatively as well as qualitatively. Different *Pinnularia* species of variable size, *Eunotia* with long lunate valves, and *Gomphonema acuminatum* var. *coronata* predominated. Large numbers of cysts of different *Crysomonades* were also found in the same sample. All together 81 different diatoms were noticed. From the ecological and geographical points of view this list is of interest. Quite a large number of the forms belong to the subaërial association, others to the mountain-bog group. These two diatom associations vary in different geographical regions, and, compared with the same groups from Central Nippon, they consist ecologically of the same genera but of different species. Among the most interesting forms recorded at Kaolingtze should be mentioned two forms of *Eunotia monodon*, var. *asiatica* and var. *koreana* fo. *undulata*, reported from South Korea; *Pinnularia nodosa* var. *hankensis*, known from Lake Hanka of eastern Siberia; *Cymbella turgida* var. *muscosa* and *Caloneis sphagnicola*, recently reported from the environs of Vladivostok.

Fourteen new species, varieties, and forms, are proposed by me from this mountain bog. They are:

Eunotia parallela fo. *asiatica* fo. nov.
Achnanthes fragilis sp. nov.
Caloneis sphagnicola sp. nov.
Pinnularia molaris var. *asiatica* var. nov.
Pinnularia subcapitata fo. *constricta* fo. nov.
Pinnularia gibba fo. *constricta* fo. nov.
Pinnularia bogotensis var. *asiatica* var. nov.
Pinnularia streptoraphe var. *asiatica* var. nov.
Pinnularia distinguenda var. *asiatica* var. nov. and fo. *striolata* fo. nov.
Cymbella Pavlovi sp. nov.
Cymbella Cesati var. *asiatica* var. nov.
Nitzschia capitellata var. *montana* var. nov.
Nitzschia ignorata var. *asiatica* var. nov.

This paper includes detailed descriptions and drawings of the new forms and points out some characteristics of the known species.

MELOSIRA DISTANS (Ehr.) Kütz. var. LIRATA (Ehr.) Bethge fo. LACUSTRIS (Grun.) Bethge.

Melosira distans (Ehr.) Kütz. var. *lirata* (Ehr.) Bethge fo. *lacustris* (Grun.) Bethge, Fr. Hustedt, Bacillar. (1930) 93, fig. 57.

Frustule with thick membrane. Valve height, 0.017 mm; breadth, 0.02. Striæ 8, puncta 6 in 0.01 mm. Infrequent. Reported from mountainous districts.

MELOSIRA ROESEANA Rabh. var. EPIDENDRON Grunow.

Melosira roeseana Rabh. var. *epidendron* Grunow, Van Heurck, Synopsis (1881–1885) pl. 89, figs. 17, 18.

A few specimens have been seen. Diameter of the valves 0.0187 mm. Marginal striæ 15 to 17 in 0.01 mm. Not rare.

TABELLARIA FENESTRATA (Lyngb.) Kützing.

Tabellaria fenestrata (Lyngb.) Kützing, Fr. Hustedt, Bacillar. (1930) 122, 123, fig. 99.

Fairly common. Valve length, 0.076 mm; breadth, 0.006.

TABELLARIA FLOCCULOSA (Roth.) Kützing.

Tabellaria flocculosa (Roth.) Kützing, Fr. Hustedt, Bacillar. (1930) 123, 124, fig. 101.

Valve length, 0.022 mm; breadth, 0.0068. Found with the preceding species.

MERIDION CIRCULARE Agardh var. CONSTRICTA (Ralfs) Van Heurck.

Meridion circulare Agardh. var. *constricta* (Ralfs) Van Heurck, Fr. Hustedt, Bacillar. (1930) 131, fig. 119.

Several specimens have been seen. Length, 0.027 mm; breadth, 0.006.

SYNEDRA ULNA (Nitz.) Ehr.

Synedra ulna (Nitz.) Ehr., Fr. Hustedt, Bacillar. (1930) 151, fig. 159.

Valve linear-lanceolate. Length, 0.207 mm; breadth, 0.0068. Striæ 9 in 0.01 mm. Rare.

EUNOTIA MONODON Ehr. var. KOREANA Skv. fo. UNDULATA Skvortzow. Plate 1, fig. 21.

Eunotia monodon Ehr. var. *koreana* Skv. fo. *undulata* Skvortzow, Neogene Diatoms from environs of Genzan, Korea (1936) pl. 1, figs. 12, 23, 24.

Valve arcuate, dorsal slightly triundulate, ventral concave. Length, 0.034 mm; breadth, 0.0068. Striæ 8 in 0.01 mm. Reported as a fossil from southern Korea.

EUNOTIA MONODON Ehr. var. ASIATICA Skvortzow.

Eunotia monodon Ehr. var. *asiatica* SKVORTZOW, Neogene diatoms from environs of Genzan, Korea (1936) pl. 1, figs. 25, 35; pl. 2, fig. 7; pl. 3, fig. 1.

Eunotia major var. *asiatica* SKVORTZOW, Alpine diatoms from South China (1929) 40, pl. 2, fig. 11.

Valve slightly curved, undulate in the middle on ventral and dorsal sides. Length, 0.085 mm; breadth, 0.008. Striæ 8 in 0.01 mm. Fairly common.

EUNOTIA PRAERUPTA Ehr. var. BIDENS Grunow.

Eunotia praerupta Ehr. var. *bidens* Grunow, FR. HUSTEDT, Bacillar. (1930) 174, fig. 213.

Common. Length, 0.066 mm; breadth, 0.012. Striæ 8 in 0.01 mm.

EUNOTIA PECTINALIS (Kütz.) Rabh. var. UNDULATA (Ralfs) Rabh.

Eunotia pectinalis (Kütz.) Rabh. var. *undulata* (Ralfs) Rabh., FR. HUSTEDT, Bacillar. (1930) 182, fig. 240.

Valve slightly arcuate with triundulate dorsal side. Ventral side only centrally undulate. Length, 0.061 mm; breadth, 0.01. Striæ 8 in 0.01 mm. A few specimens of this variety occur.

EUNOTIA ALPINA (Naeg.) Hustedt.

Eunotia alpina (Naeg.) FR. HUSTEDT, Bacillar. (1930) 185, fig. 252.

Valve narrow, filiform, curved, with broad-rounded ends. Length, 0.068 mm; breadth 0.0025. Striæ 15 in 0.01 mm. Infrequent.

EUNOTIA LUNARIS (Ehr.) Grun. var. CAPITATA Grunow.

Eunotia lunaris (Ehr.) Grun. var. *capitata* Grunow, FR. HUSTEDT, Bacillar. (1930) 185, fig. 250.

More robust than *Eunotia alpina*. Length, 0.105 mm; breadth, 0.0042. Striæ 12 to 14 in 0.01 mm. Infrequent.

EUNOTIA LUNARIS (Ehr.) Grun. var. SUBARCUATA (Naeg.) Grunow.

Eunotia lunaris (Ehr.) Grun. var. *subarcuata* (Naeg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 185, fig. 251.

Smaller than the type, with slightly attenuate ends. Length, 0.027 mm; breadth, 0.004 to 0.005. Striæ 14 in 0.01 mm. Infrequent.

EUNOTIA VENERIS (Kütz.) O. Müll.

Eunotia veneris (Kütz.) O. Müll., Fr. Hustedt, Bacillar. (1930) 182, 183, fig. 245.

Valve semielliptic, with distinct terminal nodules. Dorsal side arcuate, at ends attenuate. Length, 0.022 mm; breadth, 0.005. Striæ 13 in 0.01 mm. Not rare.

EUNOTIA TRIDENTULA Ehr. var. PERMINUTA Grunow. Plate 1, figs. 15 and 21.

Eunotia tridentula Ehr. var. *perminuta* Grunow, Fr. Hustedt, Bacillar. (1930) 180, fig. 233; A. Schmidt, Atlas Diatom. (1911) pl. 273, figs. 4–6.

Valve slightly arcuate and dorsal triundulate. Terminal nodules indistinct. Length, 0.012 to 0.0136 mm; breadth, 0.0034. Striæ 15 to 18 in 0.01 mm. Infrequent.

EUNOTIA PARALLELA Ehr. fo. ASIATICA fo. nov. Plate 1, fig. 5.

Differt a typo valvis latior, striis robustris, medium dorsali constrictis. Longis valvis 0.144 mm; latis valvis 0.0125. Striis transversis 8 ad 9 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve arcuate, with broad-rounded ends. Dorsal side with a depression, ventral with an inflation. End nodules curved and large. Along the ventral side a distinct median line. Length, 0.144 mm; breadth, 0.0125. Striæ 8 to 9 in 0.01 mm. Differs from the type in the more robust striæ and in being slightly constricted in the middle. Common. The type is reported from moss bogs in northern Europe.

ACHNANTHES LANCEOLATA Bréb.

Achnanthes lanceolata Bréb., Fr. Hustedt, Bacillar. (1930) 207, 208, fig. 306*a*.

Valve lanceolate-elliptic, with attenuate ends. Length, 0.02 mm; breadth, 0.006. Rare.

ACHNANTHES FRAGILIS sp. nov. Plate 1, fig. 21.

Valvis ellipticis cum polis rotundatis. Valva superior cum area axillaris angustata linearis, area centralis transversa dilatata. Valva inferior area centralis orbicularis. Striis delicatissimus, 40 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve elliptic, obtuse. Length, 0.0065 mm; breadth, 0.002. Upper valve with narrow axial and central area forming a broad rectangular fascia. Lower valve with suborbicular central area.

Length, 0.034 mm; breadth, 0.0068. Costæ 5 in 0.01 mm. Common.

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ILLUSTRATIONS

PLATE 1

FIGS. 1 and 2. *Pinnularia distinguenda* Cleve var. *asiatica* fo. *striolata* fo. nov.
FIG. 3. *Pinnularia nodosa* Ehr. var. *hankensis* Skv.
4. *Pinnularia distinguenda* Cleve var. *asiatica* var. nov.
5. *Gomphonema acuminatum* Ehr. var. *turris* (Ehr.) Cleve.
6. *Hantzschia amphioxys* (Ehr.) Grun. var. *gracilis* Grun.
7. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
8. *Eunotia parallela* Ehr. fo. *asiatica* fo. nov.
9. *Stenopterobia intermedia* (Lewis).
10. *Navicula Lagerheimii* Cleve var. *intermedia* Hust.
11. *Gomphonema angustatum* (Kütz.) Rabh. var. *undulata* Grun.
FIGS. 12 and 13. *Gomphonema angustatum* (Kütz.) Rabh.
FIG. 14. *Pinnularia distinguenda* Cleve var. *asiatica* var. nov.
15. *Pinnularia streptoraphe* Cleve var. *minor* Cleve.
16. *Pinnularia streptoraphe* Cleve var. *asiatica* var. nov.
17. *Cymbella turgida* (Greg.) Cleve.
18. *Cymbella turgida* (Greg.) Cleve var. *muscosa* Skv.
19. *Pinnularia isostauron* (Ehr.) Grun.
20. *Gomphonema intricatum* Kütz. var. *pumila* Grun.
21. *Nitzschia palea* (Kütz.) W. Smith.
22. *Nitzschia parvula* Lewis.
23. *Eunotia monodon* Ehr. var. *koreana* Skv. fo. *undulata* Skv.
24. *Nitzschia capitellata* Hust. var. *montana* var. nov.
25. *Eunotia tridentula* Ehr. var. *perminuta* Grun.
26. *Achnanthes fragilis* sp. nov.
27. *Caloneis sphagnicola* sp. nov.
28. *Cymbella Pavlovi* sp. nov.
29. *Hantzschia amphioxys* (Kütz.) Grun. var. *rupestris* Grun.
30. *Nitzschia ignorata* Krasske var. *asiatica* var. nov.
31. *Eunotia tridentula* Ehr. var. *perminuta* Grun.

PLATE 2

FIG. 1. *Pinnularia gentilis* (Donk.) Cleve.
2. *Pinnularia distinguenda* Cleve.
3. *Pinnularia microstauron* (Ehr.) Cleve.
4. *Pinnularia gibba* Ehr. fo. *subundulata* Mayer.
5. *Pinnularia gibba* Ehr. fo. *constricta* fo. nov.
6. *Pinnularia bogotensis* Grun. var. *asiatica* var. nov.
7. *Pinnularia nodosa* Ehr. var. *hankensis* Skv.
8. *Pinnularia mesolepta* (Ehr.) W. Smith.
9. *Pinnularia subcapitata* Greg. fo. *constricta* fo. nov.
10. *Pinnularia subcapitata* Greg. var. *Hilseana* (Janish) O. Müll.

FIG. 11. *Pinnularia subcapitata* Greg.
12. *Pinnularia major* (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* Mayer.
13. *Pinnularia brevicostata* Cleve.
14. *Pinnularia gibba* Ehr.
15. *Pinnularia isostauron* (Ehr.) Grun.
16. *Navicula atomus* (Naeg.) Grun.
17. *Pinnularia mesolepta* (Ehr.) W. Smith fo. *angusta* Cleve.
18. *Navicula placenta* Ehr.
19. *Nitzschia frustulum* (Kütz.) Grun. var. *perminuta* Grun.
20. *Cymbella Cesati* (Rabh.) Grun. var. *asiatica* var. nov.
21. *Pinnularia Braunii* (Grun.) Cleve.
22. *Gomphonema angustatum* (Kütz.) Rabh. var. *sacrophagus* (Greg.) Grun.
23. *Pinnularia nodosa* Ehr. var. *hankensis* Skv.
24. *Pinnularia molaris* Grun. var. *asiatica* var. nov.
25. *Pinnularia gibba* Ehr.
26. *Pinnularia mesolepta* (Ehr.) W. Smith.

bruised or dried, odor unpleasant, taste agreeable. Spores elliptic, obliquely apiculate, 6.6 to 8.4 μ long, 3 to 3.6 μ broad. Basidia clavate, 13.5 to 15 μ long, 3.9 to 4.5 μ broad.

LUZON, Laguna Province, Agricultural College, *Bur. Sci. 55764 J. M. Mendoza*, December 18, 1932, on the ground.

13. LEPIOTA GRACILENTA Krombholz. Plate 4, fig. 1.

Lepiota gracilenta KROMBHOLTZ in Fr., Hym. Eur. (1874) 30; SACC., Syll. Fung. 5 (1887) 32; REA, Brit. Basidiomycetae (1922) 66; RAMSBOTTOM, Hdbk. of Larger Brit. Fung. (1923) 29; BRES., Icon. Mycol. 1 (1927) 21.

Lepiota elata COPELAND in Bur. Govt. Lab. Pub. 28 (1905) 146; BROWN, Minor Products of Philip. Forest 3 (1921) 140.

Pileus at first ovate, then campanulate, finally flattened, 6 to 12 cm in diameter, umbonate, whitish, covered with fuscous cuticle, cuticle later breaking up into scales; margin smooth. Stem whitish, covered with fine yellowish scales, gradually tapering upward from a subglobous base, 10 to 15 cm long, 0.5 to 1 cm in diameter. Annulus whitish, cottony, movable, early disappearing. Gills free, separated from stem by a broad cartilaginous ring, very crowded. Flesh white, odor agreeable, taste pleasant. Spores hyaline, subelliptic, 9.6 to 12.0 μ long, 7.5 to 9.0 μ broad. Basidia clavate, 16.0 to 21.0 μ long, 7.5 to 8.4 μ broad. Cystidia bottle-shaped, ventricose, 45.0 to 66.0 μ long, 13.5 to 15.0 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 2417 P. S. Gener*, May 29, 1935, on ground; *Philip. Nat. Herb. 2419 B. Reyes*, May 31, 1935, on ground; *Philip. Nat. Herb. 2489 P. S. Gener*, July 5, 1935, on ground.

We have decided to place *L. elata* Copel. as a synonym to *L. gracilenta* Krombh. because of the following characters: the caps of *L. elata* Copel. and *L. gracilenta* Krombh. are conical at first and remain distinctly umbonate when fully flattened, covered throughout with fine silky scales. In both the gills are white at first becoming wine-colored upon touching. The two species also agree in all microscopic details, as size of spores and basidia.

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ILLUSTRATIONS

PLATE 1

FIG. 1. *Lepiota philippinensis* Mendoza sp. nov.; × 0.7.
2. Spores of *Lepiota philippinensis* Mendoza sp. nov.; × 450.
3. Spores of *Lepiota procera* Fries; × 450.

PLATE 2

Lepiota cepaestipes Fries; × 0.07.

PLATE 3

Lepiota morgani Peck; × 0.8.

PLATE 4

FIG. 1. *Lepiota americana* Peck; × 0.425.
2. *Lepiota cristata* Peck; × 0.425.
3. *Lepiota gracilenta* Krombholtz; × 0.6.

PLATE 5

FIG. 1. *Lepiota lilacea* Bresadola; × 0.7.
2. *Lepiota candida* Copeland; × 0.8.

PLATE 6

FIG. 1. *Lepiota denudata* Rabenhorst; × 0.44.
2. *Lepiota metulispora* Berkeley and Broome; × 0.78.

PLATE 7

FIG. 1. *Lepiota hispida* Lasch; × 1.
2. *Lepiota meleagris* Sowerby; × 3.

Striæ very fine, about 40 in 0.01 mm. A distinct minute species. Infrequent.

CALONEIS SPHAGNICOLA sp. nov. Plate 1, fig. 17.

Valvis lineari-lanceolatis ad medium modice inflatis, cum polis subcuneatis et rotundatis. Raphe directa cum poris medianis approximatis. Area axillaris anguste-linearis. Striis tenuissimis subradiantibus, 25 in 0.01 mm, medio valvae vitta transversa nuda interruptis. Longis valvis 0.039 mm; latis valvis 0.0005. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear-lanceolate, with gibbous middle, and slightly attenuate ends. Median line filiform, with distinct comma-shaped terminal fissures. Axial area narrow-linear, central area a broad rectangular fascia. Striæ slightly radiate, with a distinct longitudinal band. Length, 0.039 mm; breadth, 0.005. Striæ 25 in 0.01 mm. Infrequent. A distinct species akin to *Caloneis bacillum* (Greg.) Meresch. and *Caloneis silicula* (Ehr.) Cleve. Recently found near Vladivostok in a *Sphagnum* bog.

STAURONEIS PHOENICENTERON Ehr. fa. **GRACILIS** Dippel.

Stauroneis phoenicenteron Ehr. fo. *gracilis* Dippel, FR. HUSTEDT, Bacillar. (1930).

Fairly common. Length, 0.08 mm; breadth, 0.015. Striæ 17 to 18 in 0.01 mm.

STAURONEIS ANCEPS Ehr. fa. **GRACILIS** (Ehr.) Cleve.

Stauroneis anceps Ehr. fo. *gracilis* (Ehr.) Cleve, FR. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Less common than *Stauroneis phœnicenteron*. Length, 0.062 mm; breadth, 0.012. Striæ in 0.01 mm.

NAVICULA CRYPTOCEPHALA Kützing.

Navicula cryptocephala Kützing, FR. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate, with broad-rounded ends. Length, 0.03 mm; breadth, 0.005. Striæ 17 in 0.01 mm. Infrequent.

NAVICULA PUPULA Kütz. var. **RECTANGULARIS** (Greg.) Grunow.

Navicula pupula Kütz. var. *rectangularis* (Greg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 281, fig. 467b.

Valve linear, with broad-rounded ends. Length, 0.02 mm; breadth, 0.0051. Not common.

NAVICULA LAGERHEIMI Cleve var. **INTERMEDIA** Hustedt. Plate 1, fig. 14.

Navicula Lagerheimii Cleve var. *intermedia* Hustedt, A. SCHMIDT, Atlas Diatom. (1930) pl. 370, fig. 22.

Valve lanceolate, with broad-rounded ends. Length, 0.03 mm; breadth, 0.0085. Striæ 18 in 0.01 mm. Reported from Harbin, Maoershan, in northern Manchoukuo, and from Shanghai and Hangchow, China. Common in the Tropics.

NAVICULA ATOMUS (Naeg.) Grunow. Plate 2, fig. 16.

Navicula atomus (Naeg.) Grunow, FR. HUSTEDT, Bacillar. (1930) 289, fig. 484.

Valve elliptic-lanceolate, with broad ends. Length, 0.0085 mm; breadth, 0.0034. Striæ 25 in 0.01 mm. Infrequent.

NAVICULA PLACENTA Ehr. Plate 2, fig. 18.

Navicula placenta Ehr., FR. HUSTEDT, Bacillar. (1930) 290, fig. 492.

Valve elliptic, with small rostrate ends. Median line filiform, with distinct central nodules. Axial area narrow-linear, central slightly enlarged. Striæ areolate, unipunctate in the system, or oblique, curved, and crossing each other. Length, 0.0408 mm; breadth, 0.0165. Striæ about 20 in 0.01 mm. New to Manchoukuo.

Genus PINNULARIA Ehrenberg

PINNULARIÆ PARALLELISTRIATÆ

PINNULARIA MOLARIS Grun. var. ASIATICA var. nov. Plate 1, fig. 14.

Differt a typo valvis robustis cum polis elongatis. Longis valvis 0.049 mm; latis valvis 0.0085. Costis 10 ad 11 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear-lanceolate, with attenuate, cuneate ends. Central area a fascia, widened outwards. Length, 0.049 mm; breadth, 0.0085. Costæ divergent in the middle and convergent at the ends, 10 to 11 in 0.01 mm. Differs from the type in its more elongate ends and more robust striæ. Infrequent.

PINNULARIÆ CAPITATÆ

PINNULARIA SUBCAPITATA Greg. Plate 1, fig. 11.

Pinnularia subcapitata Greg., FR. HUSTEDT, Bacillar. (1930) 317, fig. 571.

Valve linear, with subcapitate ends. Axial area linear, central a fascia widened outwards. Striæ divergent in the middle and convergent at the ends. Length, 0.029 mm; breadth, 0.005. Costæ 12 in 0.01 mm. Not common.

PINNULARIA SUBCAPITATA Greg. fo. CONSTRICTA fo. nov. Plate 2, fig. 9.

Differt a typo valvis modice constrictis, striis robustis. Longis valvis 0.027 ad 0.029 mm; latis valvis 0.0042 ad 0.0045. Costis

10 ad 11 in 0.01 mm. Habit. in aquis stagnalis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Differs from the type in its slightly constricted middle part and more robust costæ. Length, 0.027 to 0.029 mm; breadth, 0.0042 to 0.0045. Costæ 10 to 11 in 0.01 mm. Not common.

PINNULARIA SUBCAPITATA Greg. var. **HILSEANA** (Janisch) O. Müll. Plate 2, fig. 14.

Pinnularia subcapitata Greg. var. *Hilseana* (Janish) O. Müll., Fr. Hustedt, Bacillar. (1930) 317, fig. 52.

Like the type, but with elongate and subcapitate ends. Length, 0.03 mm; breadth, 0.0042. Costæ 12 in 0.01 mm. Infrequent.

PINNULARIA MESOLEPTA (Ehr.) W. Smith. Plate 2, figs. 9 and 16.

Pinnularia mesolepta Ehr. var. *stauroneiformis* A. Schmidt, Atlas Diatom. (1876) pl. 45, figs. 52, 53.

Valve linear, triundulate, with capitate ends. Median line with distinct comma-shaped terminal fissures. Central area a broad transverse fascia, widened outwards. Length, 0.0408 to 0.049 mm; breadth, 0.0068. Costæ 10 to 12 in 0.01 mm. Differs from the type in its narrower valves. Not rare.

PINNULARIA MESOLEPTA (Ehr.) W. Smith fo. **ANGUSTA** Cleve. Plate 2, fig. 17.

Pinnularia mesolepta (Ehr.) W. Smith fo. *angusta* Cleve, Fr. Hustedt, Bacillar. (1930) 319, fig. 575b.

Narrower than the type. Length, 0.04 mm; breadth, 0.0068. Costæ 10 to 11 in 0.01 mm, convergent at the ends. Rare.

PINNULARIA BRAUNII (Grun.) Cleve. Plate 2, fig. 21.

Pinnularia Braunii (Grun.) Cleve, Fr. Hustedt, Bacillar. (1930) 319, fig. 577.

Valve elliptic-lanceolate, with produced and capitate ends. Length, 0.035 to 0.04 mm; breadth, 0.0068. Costæ 12 to 13 in 0.01 mm. Fairly common.

PINNULARIÆ DIVERGENTES

PINNULARIA MICROSTAURON (Ehr.) Cleve. Plate 1, fig. 3.

Pinnularia microstauron (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 320, fig. 582.

Valve linear-lanceolate, with produced and subrostrate ends. Central area a broad fascia, widened outwards. Length, 0.046 mm; breadth, 0.0085. Costæ 11 to 12 in 0.01 mm. Infrequent.

PINNULARIÆ TABELLARIÆ

PINNULARIA GIBBA Ehr. Plate 2, figs. 14 and 25.

Pinnularia gibba Ehr., Fr. Hustedt, Bacillar. (1930) 327, fig. 600.

Valve linear-lanceolate, with attenuate, subcapitate, cuneate ends. Axial area linear, widened towards the central area, forming a broad rectangular fascia. Terminal fissures large, comma-shaped. Costæ divergent in the middle and convergent at the ends, 8 to 9 in 0.01 mm. Length, 0.085 to 0.111 mm; breadth, 0.01 to 0.012. Common.

PINNULARIA GIBBA Ehr. var. **LINEARIS** Hustedt.

Pinnularia gibba Ehr. var. *linearis* Hustedt, FR. HUSTEDT, Bacillar. (1930) 327, fig. 604.

Valve linear, with obtuse-rounded ends. Length, 0.051 mm; breadth, 0.006. Costæ 10 in 0.01 mm. Less common than *Pinnularia gibba* Ehr.

PINNULARIA GIBBA Ehr. fo. **SUBUNDULATA** Mayer. Plate 1, fig. 4.

Pinnularia gibba Ehr. fo. *subundulata* Mayer, FR. HUSTEDT, Bacillar. (1930) 327, fig. 601.

Valve with slightly undulate margins. Length, 0.059 to 0.061 mm; breadth, 0.0072 to 0.01. Costæ 9 in 0.01 mm. Not rare.

PINNULARIA GIBBA Ehr. fo. **CONSTRICTA** fo. nov. Plate 1, fig. 5.

Differt a typo valvis modice constrictis. Longis valvis 0.047 mm; latis valvis 0.0063. Costis 9. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, constricted in the middle. Ends broad and rounded. Length, 0.047 mm; breadth, 0.0063. Costæ 9 in 0.01 mm. Differs from the type in its constricted valves. Infrequent.

PINNULARIA BOGOTENSIS Grun. var. **ASIATICA** var. nov. Plate 1, fig. 6.

Differt a typo valvis minoribus, et costis robustris. Longis valvis 0.059 mm; latis valvis 0.0085. Costis 10 ad 11 in 0.01 mm. Habit. in aquis stagnalibus alpestris prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, slightly attenuate towards the rounded and cuneate ends. Axial area somewhat dilated in the middle. Central area a broad transverse fascia. Length, 0.059 mm; breadth, 0.0085. Costæ 10 to 11 in 0.01 mm, divergent in the middle and convergent at the ends. Differs from the type[1] in its smaller size and more robust costæ. *Pinnularia bogotensis* belongs to the group of *Pinnularia gibba* and is known from New Grenada, Maine, North America, and from Korea.

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[1] A. Schmidt, Atlas Diatom. (1876) pl. 44, figs. 30–32.

PINNULARIÆ DISTANTES

PINNULARIA BOREALIS Ehr.

Pinnularia borealis Ehr., FR. HUSTEDT, Bacillar. (1930) 326, fig. 597.

Valve linear, with obtuse ends. Median line robust. Costæ slightly radiate, 4 in 0.01 mm. Length, 0.039 mm; breadth, 0.01. Few specimens have been seen.

PINNULARIÆ BREVISTRIATÆ

PINNULARIA BREVICOSTATA Cleve. Plate 2, fig. 13.

Pinnularia brevicostata CLEVE, Diatoms of Finland (1891) 25, pl. 1, fig. 6.

Valve linear, with obtuse-rounded ends. Median line flexuous, with large comma-shaped terminal fissures. Axial area broad-linear, central area sometimes with a rectangular fascia. Length, 0.072 mm; breadth, 0.01. Costæ 9 in 0.01 mm. Common.

PINNULARIA ACROSPHAERIA Bréb.

Pinnularia acrosphaeria Bréb., FR. HUSTEDT, Bacillar. (1930) 330, fig. 610.

Valve linear, with triundulate margin and capitate ends. Median line broad and punctate. Length, 0.081 mm; breadth, in the middle 0.012, at the ends 0.0156. Costæ 11 in 0.01 mm, almost parallel. Uncommon. Reported from mountainous districts.

PINNULARIA NODOSA Ehr. var. HANKENSIS Skvortzow. Plate 1, fig. 4; Plate 2, figs. 7 and 24.

Pinnularia nodosa Ehr. var. *hankensis* SKVORTZOW, Diatoms from Hanka Lake (1929) 27, pl. 6, fig. 16.

Valve linear, triundulate, with produced, subcapitate ends. Median line filiform. Axial and central areas fine-punctate. Length, 0.04 to 0.066 mm; breadth, 0.005 to 0.0068. Costæ 8 to 10 in 0.01 mm, convergent at the ends. Common. Reported from Hanka Lake, eastern Siberia.

PINNULARIÆ MAJORES

PINNULARIA MAJOR (Kütz.) Cleve var. LINEARIS Cleve fo. NEGLECTA Mayer. Plate 2, fig. 12.

Pinnularia major (Kütz.) Cleve var. *linearis* Cleve fo. *neglecta* MAYER, Die Bacillar. der Regensburger Gewässer (1912) 213, pl. 22, fig. 3.

Valve linear, with slightly attenuate-rounded ends. Median line robust, with large comma-shaped terminal fissures. Axial and central area broad-linear, more than ⅓ the breadth of valve.

Length, 0.127 mm; breadth, 0.0175. Costæ 6 in 0.01 mm, slightly divergent in the middle and convergent at the ends. Infrequent.

PINNULARIÆ COMPLEXÆ

PINNULARIA VIRIDIS (Nitz.) Ehr. var. FALLAX Cleve.

Pinnularia sp., A. SCHMIDT, Atlas Diatom. (1876) pl. 43, fig. 24.

Valve linear, with very narrow axial area. Length, 0.045 mm; breadth, 0.0085. Costæ 9 in 0.01 mm. Infrequent.

PINNULARIA VIRIDIS (Nitz.) Ehr. var. SUDETICA (Hilse) Hust.

Pinnularia viridis (Nitz.) Ehr. var. *sudetica* (Hilse) Hust., FR. HUSTEDT, Bacillar. (1930) 335, fig. 617*b*.

Valve linear-lanceolate, with slightly attenuate-rounded ends. Axial area narrow-linear, central slightly enlarged. Length, 0.078 mm; breadth, 0.012. Costæ 9 to 10 in 0.01 mm. Longitudinal band distinct. Fairly common.

PINNULARIA GENTILIS (Donk.) Cleve. Plate 2, fig. 1.

Pinnularia gentilis Donkin, A. SCHMIDT, Atlas Diatom. (1876) pl. 42, fig. 2.

Valve linear with broad-rounded ends. Median line narrow, not strongly complex. Axial area narrow, somewhat less than ¼ the breadth of valve. Costæ slightly divergent in the middle and convergent at the ends, 7 in 0.01 mm, with broad longitudinal band. Length, 0.125 mm; breadth, 0.02. Common.

PINNULARIA NOBILIS Ehr.

Pinnularia nobilis Ehr., FR. HUSTEDT, Bacillar. (1930) 337, fig. 619.

Valve linear, slightly gibbous in the middle, and broad, slightly capitate, ends. Length, 0.21 to 0.235 mm; breadth, 0.028 to 0.034. Costæ 5 to 6 in 0.01 mm. Common.

PINNULARIA STREPTORAPHE Cleve forma.

Pinnularia streptoraphe Cleve, FR. HUSTEDT, Bacillar. (1930) 337, fig. 620.

Valve linear, with parallel margins and broad-rounded ends. Length, 0.136 mm; breadth, 0.022. Axial area narrow, about ¼ the valve breadth. Central area slightly enlarged. Median line distinct-complex. Costæ 5, slightly radiate, convergent at the ends. Smaller than the type. Longitudinal band distinct. Infrequent.

PINNULARIA STREPTORAPHE Cleve var. **MINOR** Cleve. Plate 1, fig. 15.

Pinnularia viridis var. *minor* CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 2.

Valve linear, with obtuse and rounded ends. Length, 0.081 to 0.101 mm; breadth, 0.011. Costæ 8 to 9 in 0.01 mm, interrupted in the middle. Median line complex. Longitudinal band distinct. Differs from the type in its broader valve and coarser costæ. Common.

PINNULARIA STREPTORAPHE Cleve var. **ASIATICA** var. nov. Plate 1, fig. 16.

Minor quam forma typica, modice medium inflexis. Longis valvis 0.107 ad 0.139 mm; latis valvis 0.013 ad 0.015. Costis 6 ad 7 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, with slightly gibbous margin and broad-rounded ends. Axial area somewhat less than ¼ the breadth of valve, linear, slightly enlarged in the middle. Median line distinct-complex. Costæ radiate in the middle, slightly convergent at the ends, 6 to 7 in 0.01 mm. Length, 0.107 to 0.139 mm; breadth, 0.013 to 0.015. Differs from the type in its smaller valves and in being slightly gibbous in the middle. Common.

PINNULARIA DISTINGUENDA Cleve. Plate 1, fig. 2.

Pinnularia viridis var. *distinguenda* CLEVE, Diatoms of Finland (1891) 22, pl. 1, fig. 1.

Valve linear, gibbous in the middle. Ends rounded. Axial area linear, somewhat less than ¼ of valve breadth. Central area slightly enlarged. Median line not strongly complex. Costæ divergent in the middle and convergent at the ends, with distinct, narrow, longitudinal band. Length, 0.153 mm; breadth, 0.02. Costæ 7 to 7½ in 0.01 mm. Common.

PINNULARIA DISTINGUENDA Cleve var. **ASIATICA** var. nov. Plate 1, figs. 4 and 14.

Differt a typo valvis angustis, striis vittam longitudinalem arcuatam notatae. Longis valvis 0.083 mm; latis valvis 0.016. Costis 6 ad 7 in 0.01 mm. Habit. in aquis stagnalis alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, with parallel margins and more or less cuneate ends. Axial area linear, central enlarged. Median line strongly complex. Costæ robust, 6 to 7 in 0.01 mm, with broad longitudinal band. Length, 0.093 to 0.105 mm; breadth, 0.015 to 0.017. Differs from the type in its narrower valves and in the presence of distinct longitudinal bands. Common.

PINNULARIA DISTINGUENDA Cleve var. **ASIATICA** var. nov. fo. **STRIOLATA** fo. nov. Plate 1, figs. 1 and 2.

Valvis var. asiatica consimilis. Differt striis fronte viza hyalina, pone longitudinali striolata. Longis valvis 0.09 mm; latis valvis 0.015. Costis 6 ad 7 in 0.01 mm. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear, with distinct cuneate-obtuse ends. Axial area linear, central suborbicular. Median line complex. Costæ 6 to 7 in 0.01 mm, hyaline above, lineate below. Common.

PINNULARIA ISOSTAURON (Ehr.) Grunow. Plate 1, fig. 14; Plate 2, fig. 15.

Pinnularia isostauron (Ehr.) A. Grunow, Arctische Diatomeen (1880) 27, pl. 1, fig. 14.

Valve linear, with slightly attenuate and rounded ends. Median line indistinctly complex. Axial and central area broad-linear, in the middle with short rectangular fascia. Longitudinal bands distinct or indistinct. Length, 0.052 to 0.062 mm; breadth, 0.01. Costæ 7 to 8 in 0.01 mm, slightly radiate in the middle and convergent at the ends. Common. Broader than the type.

AMPHORA OVALIS Kütz. var. **LIBYCA** (Ehr.) Cleve.

Amphora libyca Ehr., A. Schmidt, Atlas Diatom. (1875) pl. 26, fig. 105.

Frustule elliptic, with truncate ends. Length, 0.03 mm; breadth, 0.008. Dorsal sides of central area a rectangular unilateral stauros. Infrequent.

CYMBELLA VENTRICOSA Kützing.

Cymbella ventricosa Kützing, Fr. Hustedt, Bacillar. (1930) 359, fig. 661.

Common. Length, 0.02 mm; breadth, 0.005. Striæ 12 to 13 in 0.01 mm.

CYMBELLA TURGIDA (Greg.) Cleve. Plate 1, fig. 17.

Cymbella turgida (Greg.) Cleve, Fr. Hustedt, Bacillar. (1930) 358, fig. 660.

Valve semielliptic or boat-shaped, with straight ventral and arcuate dorsal side. Length, 0.0289 mm; breadth, 0.0052. Ventral and dorsal striæ 9 in 0.01 mm. Smaller than the type.

Var. *minor* Skv., akin to this species, was described by the writer from Ikeda Lake, Nippon. Infrequent.

CYMBELLA TURGIDA (Greg.) Cleve var. **MUSCOSA** Skvortzow. Plate 1, fig. 14.

> *Cymbella turgida* (Greg.) Cleve var. *muscosa* SKVORTZOW, Fresh-water diatoms from the environs of Vladivostok pl. 1, fig. 17.

Valve lunate, with slightly gibbous ventral and arcuate dorsal margins. Ends attenuate. Length, 0.039 mm; breadth, 0.0085. Dorsal and ventral striæ 8 in 0.01 mm. Infrequent. Reported from a moss bog from the environs of Vladivostok, eastern Siberia.

CYMBELLA GRACILIS (Rabh.) Cleve.

> *Cymbella gracilis* (Rabh.) Cleve, FR. HUSTEDT, Bacillar. (1930) 359, fig. 663.

Valve asymmetrical, narrow, semielliptic, with long and obtuse ends. Length, 0.030 mm; breadth, 0.0068. Ventral striæ 10, dorsal 8 in 0.01 mm. Common. Reported from mountain districts.

CYMBELLA PAVLOVI sp. nov. Plate 1, fig. 26.

Valvis asymmetricis, naviculiformis, anguste-ellipticis et lanceolatis, modice arcuatis ad marginem leniter inflatis, cum polis subrostratis et subcapitatis. Raphe modice curvata. Area axilliaris linearis-angustata, centralis rodundata. Striis radiantibus ventralis 12, dorsalis 11, polis 18 in 0.01 mm. Longis valvis 0.04 mm; latis valvis 0.009. A grege *Cymbella naviculiformis* Auersv. et *Cymbella amphycephala* Naeg. et *Cymbella similis* Kraske. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve asymmetrical, naviculiform, with one side straight, the other slightly convex. Median line straight and filiform. Axial area linear, somewhat less than ¼ of the valve breadth. Central area broad, suborbicular. Striæ radiate throughout. Length, 0.04 mm; breadth, 0.009. Ventral striæ 12, dorsal 11, at the ends 18 in 0.01 mm. Infrequent.

CYMBELLA CESATI (Rabh.) Grun. var. **ASIATICA** var. nov. Plate 1, fig. 20.

Differt a typo striis robustis et area axillaris et centralis angusto lanceolatis. Longis valvis 0.051 mm; latis valvis 0.006. Striis ventralis 13, dorsalis 12 in 0.01 mm. Habit. in aquis stagnalis prope Kaolingtze, Pin-Chang-Sheng Prov., Manchoukuo, Legit B. W. Skvortzow.

Valve slightly asymmetrical, narrow-lanceolate, with long-attenuate ends. Median line with large bayonet-shaped terminal fissures and distinct central nodules bent to one side. Axial and central areas narrow-lanceolate. Striæ radiate, slightly convergent at the ends, ventral 13, dorsal 12 in 0.01 mm. Length, 0.051 mm; breadth, 0.006. Differs from the type in its more robust striæ. Infrequent. Known from Europe in mountainous districts.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith, FR. HUSTEDT, Bacillar. (1930) 370, fig. 680.

Length, 51 mm; breadth, 0.0085. Striæ 10 in 0.01 mm. Very common.

GOMPHONEMA ACUMINATUM Ehr. var. TURRIS (Ehr.) Cleve. Plate 1, fig. 5.

Gomphonema acuminatum Ehr. var. *turris* (Ehr.) Cleve, A. SCHMIDT, Atlas Diatom. (1902) pl. 239, fig. 36.

Valve clavate, with elongate and cuneate upper part and attenuate subacute lower part. Isolated puncta distinct. Length, 0.044 mm; breadth, 0.0068. Striæ 9 in 0.01 mm. Infrequent.

GOMPHONEMA PARVULUM (Kütz.) Grunow.

Gomphonema parvulum (Kütz.) Grunow, FR. HUSTEDT, Bacillar. (1930) 372, fig. 713*a*.

Common. Length, 0.022 mm; breadth, 0.005. Striæ 12 in 0.01 mm.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. EXILISSIMA Grunow.

Gomphonema parvulum (Kütz.) Grun. var. *exilissima* Grunow, VAN HEURCK, Synopsis (1881–1885) pl. 25, fig. 12.

Length, 0.017 mm; breadth, 0.0034. Striæ 12 to 13 in 0.01 mm. Infrequent.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. Plate 1, figs. 12 and 13.

Gomphonema angustatum (Kütz.) Rabh., A. SCHMIDT, Atlas Diatom. (1902) pl. 234, figs. 23, 24.

Valve clavate, with apex more robust than the lower part of the valve. Length, 0.018 to 0.027 mm; breadth, 0.0018 to 0.005. Striæ 15 in 0.01 mm. Not common.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. var. SACROPHAGUS (Greg.) Grunow. Plate 2, fig. 22.

Gomphonema angustatum (Kütz.) Rabh. var. *sacrophagus* (Greg.) Grunow, A. SCHMIDT, Atlas Diatom. (1902) pl. 234, fig. 36.

Valve with parallel margins and obtuse rostrate ends. Length, 0.022 mm; breadth, 0.0051. Striæ 9 in 0.01 mm. Infrequent.

GOMPHONEMA ANGUSTATUM (Kütz.) Rabh. var. UNDULATA Grunow. Plate 1, fig. 11.

Gomphonema angustatum (Kütz.) Rabh. var. *undulata* Grunow, FR. HUSTEDT, Bacillar. (1930) 373, fig. 694.

Valve clavate-lanceolate, with slightly triundulate margins. Apex obtuse. Length, 0.032 mm; breadth, 0.005. Not common.

GOMPHONEMA INTRICATUM Kütz. var. PUMILA Grunow. Plate 1, fig. 28.

Gomphonema intricatum Kütz. var. *pumila* Grunow, A. SCHMIDT, Atlas Diatom. (1902) pl. 234, figs. 56, 57.

Valve clavate, tapering from the middle to the subacute ends. Striæ robust, 12 in 0.01 mm. Length, 0.022 mm; breadth, 0.0034. Rare.

HANTZSCHIA AMPHIOXYS (Kütz.) Grun. fo. CAPITATA O. Müll.

Hantzschia amphioxys (Kütz.) Grun. fo. *capitata* O. Müll., FR. HUSTEDT, Bacillar. (1930) 394, fig. 748.

Valve slightly arcuate, with capitate ends. Length, 0.059 mm; breadth, 0.0068. Keel puncta 7, striæ 18 to 20 in 0.01 mm. Infrequent.

HANTZSCHIA AMPHIOXYS (Kütz.) Grun. var. RUPESTRIS Grunow. Plate 1, fig. 29.

Hantzschia amphioxys (Kütz.) Grun. var. *rupestris* Grunow, A. SCHMIDT, Atlas Diatom. (1922) pl. 345, fig. 14.

Valve arcuate, with concave dorsal margin and rostrate ends. Length, 0.064 mm; breadth, 0.01. Keel puncta 5, striæ 13 in 0.01 mm. Infrequent.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. GRACILIS Hustedt. Plate 1, fig. 6.

Hantzschia amphioxys (Ehr.) Grun. var. *gracilis* Hustedt, A. SCHMIDT, Atlas Diatom. (1921) pl. 329, figs. 6–8.

Longer than the preceding variety. Ends attenuate and reflexed. Length, 0.17 mm; breadth, 0.012. Keel puncta 7, striæ 15 to 17 in 0.01 mm. Reported from fresh water in Europe.

NITZSCHIA PALEA (Kütz.) W. Smith. Plate 1, fig. 21.

Nitzschia palea (Kütz.) W. Smith, VAN HEURCK, Synopsis (1881–1885) pl. 99, fig. 22.

Valve linear, with parallel margins and attenuate ends. Length, 0.027 mm; breadth, 0.0034. Costæ 12 to 13 in 0.01 mm. Striæ indistinct. Common.

NITZSCHIA FRUSTULUM (Kütz.) Grun. var. PERMINUTA Grunow. Plate 1, fig. 7; Plate 2, fig. 15.

Nitzschia frustulum (Kütz.) Grun. var. *tenella* Grun., VAN HEURCK, Synopsis (1881–1885) pl. 99, fig. 80.

Valve linear, with slightly attenuate and obtuse ends. Length, 0.015 to 0.0238 mm; breadth, 0.002 to 0.0025. Keel puncta 10 to 12, striæ about 30 in 0.01 mm. Infrequent.

NITZSCHIA PARVULA Lewis. Plate 1, fig. 22.

Nitzschia parvula Lewis, A. SCHMIDT, Atlas Diatom. (1921) pl. 336, figs. 12-19.

Valve slightly sigmoid, constricted in the middle. Length, 0.035 mm; breadth, 0.005. Keel puncta 7 to 8 in 0.01 mm, striæ indistinct. Reported from fresh and brackish water.

NITZSCHIA CAPITELLATA Hust. var. **MONTANA** var. nov. Plate 1, fig. 26.

Valvis linearis, prae formae typica minores et latior. Longis valvis, 0.027 mm; latis valvis 0.0025. Punctis carinalibus 12, striis transversis indistinctis, delicatissimis. Habit. in aquis stagnalis prope Kaolingtze, Pin-Chang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve linear with parallel margins and attenuate-capitate ends. Keel puncta 12 in 0.01 mm. Striæ very fine. Length, 0.027 mm; breadth, 0.0025. Differs from the type in its smaller size and broader valves. Infrequent.

NITZSCHIA IGNORATA Krasske var. **ASIATICA** var. nov. Plate 1, fig. 30.

Valvis sigmoidea, prae forma typica polis attenuatis et subacutis. Longis valvis 0.074 ad 0.076 mm; latis valvis 0.005 ad 0.0055. Punctis carinalibus 5 ad 7 in 0.01 mm. Striis transversalis indistinctis. Habit. in aquis stagnalibus alpinis prope Kaolingtze, Pin-Chiang-Sheng Prov., Manchoukuo. Legit B. W. Skvortzow.

Valve slightly sigmoid, elongate, with parallel margins and cuneate-obtuse ends. Length, 0.074 to 0.076 mm; breadth, 0.005 to 0.0055. Keel puncta 5 to 7 in 0.01 mm. Striæ very fine, indistinct. Differs from the type in its abruptly attenuate and subacute ends. The type is reported from fresh water in Europe.

STENOPTEROBIA INTERMEDIA (Lewis). Plate 1, fig. 9.

Stenopterobia intermedia (Lewis) FR. HUSTEDT, Bacillar. (1930) 428, 429, fig. 830.

Valve strongly sigmoid, slightly attenuate towards the ends. Length, 0.091 mm; breadth, 0.0055. Costæ 4, striæ 20 in 0.01 mm. Smaller than the type. An alpine diatom.

SURIRELLA ANGUSTATA Kützing.

Surirella angustata Kützing, FR. HUSTEDT, Bacillar. (1930) 435, figs. 844, 845.

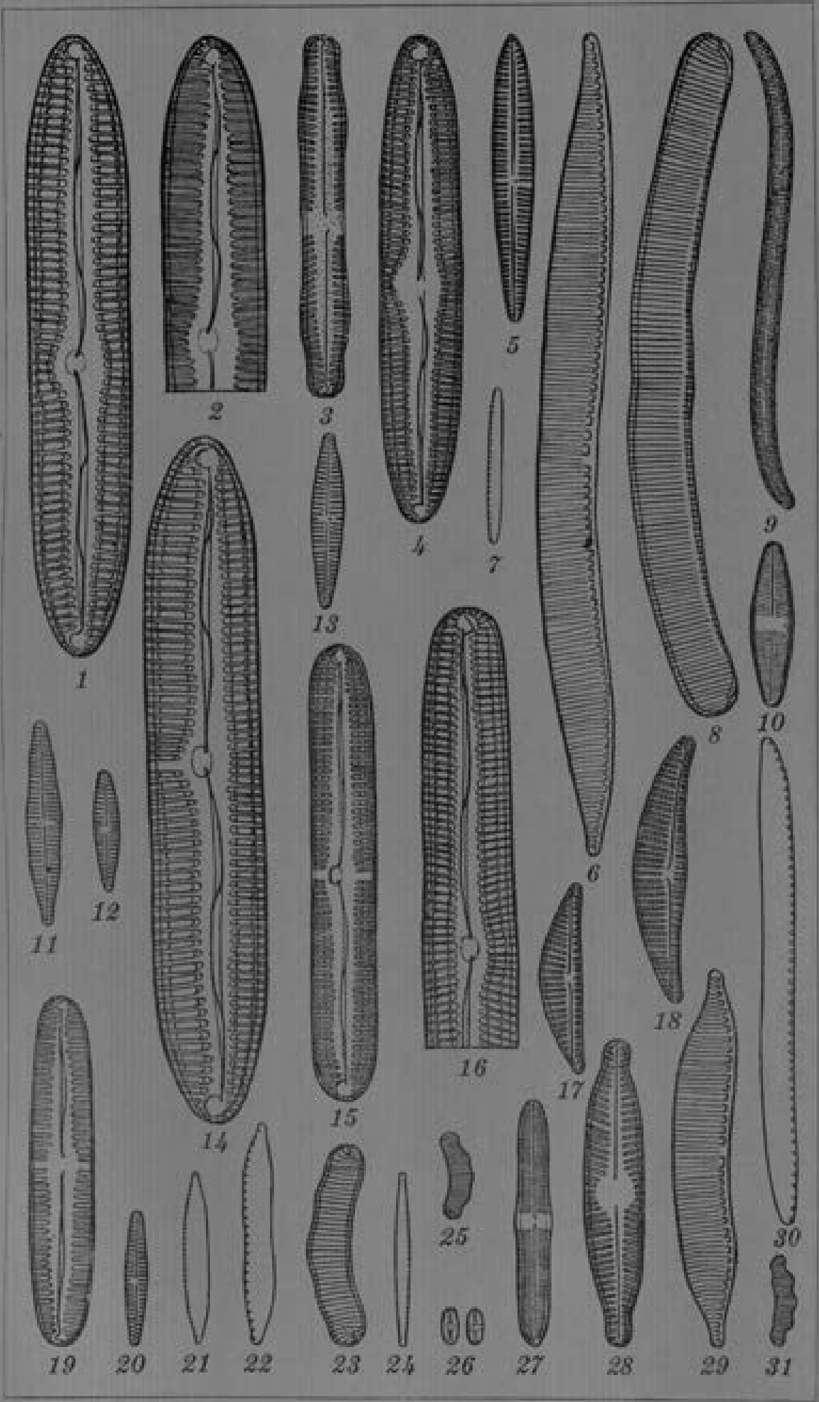
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PLATE 1.

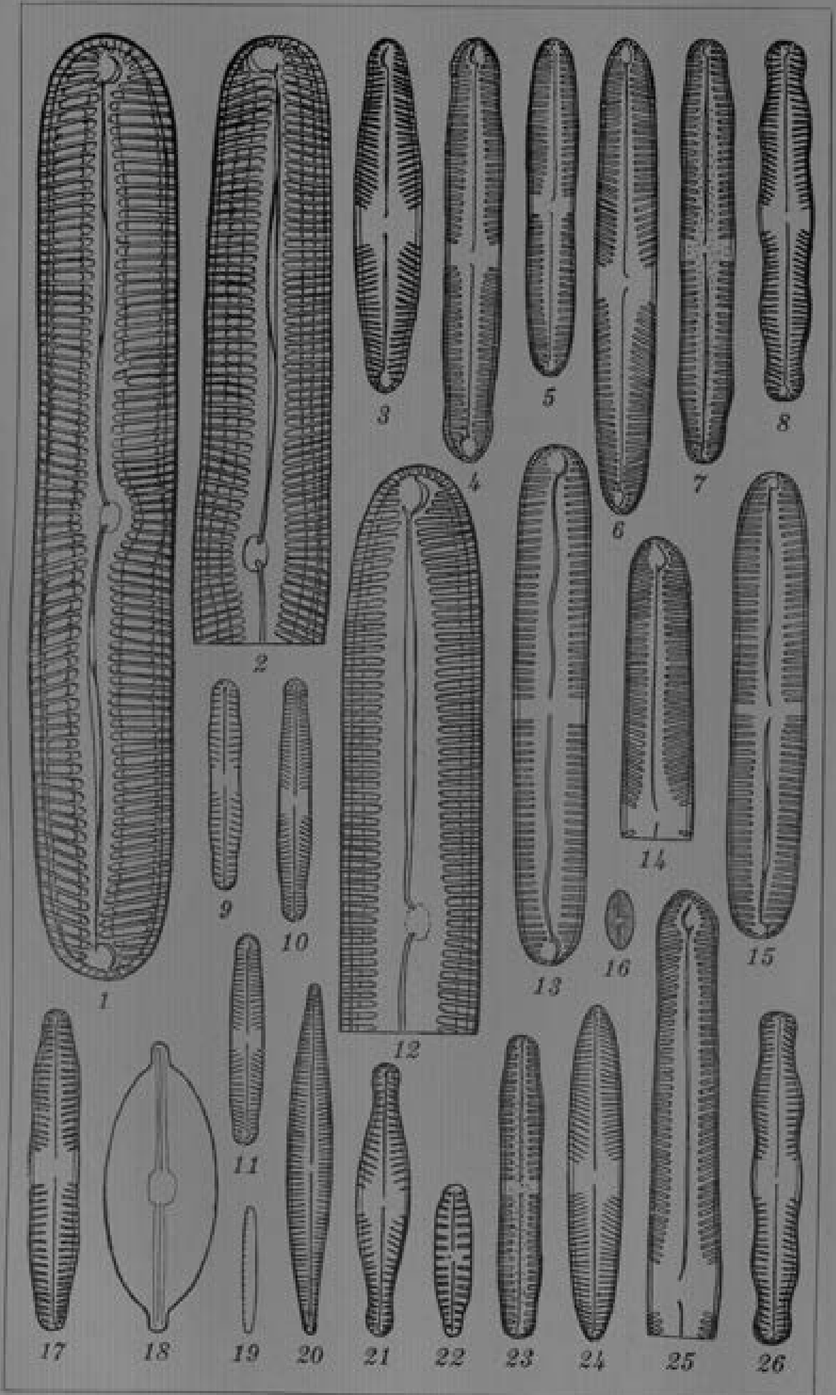

PLATE 2.

A REVISION OF PHILIPPINE LEPIOTA

By José Miguel Mendoza and Simeona Leus-Palo
Of the National Museum Division, Bureau of Science, Manila

SEVEN PLATES

Revision of the genus *Lepiota* in the Philippines is necessary because of existing nomenclatural confusion. For example, what is called *L. chlorospora* in the Philippines is *L. morgani* in the United States. Besides, some species have two or more names, like *L. candida*, a species of Copeland, which is named *L. pulcherrima* by Graff who regarded it as a new species. Another interesting case is *L. americana* Peck, later described in the Philippines by Copeland as *Psalliota* (*A.*) *boltoni*.

Many of the species here described are reported for the first time from the Philippines.

Genus LEPIOTA Fries

Lepiota Fries, Syst. Myc. 1 (1836) 19; Cooke, Hdbk. Brit. Fungi (1871) 11; Sacc., Syll. Fung. 5 (1877) 27; Massee, Brit. Fungus-Flora 3 (1893) 232; Morgan, Journ. Mycol. 12 (1906) 154–156; Atkinson, Mushrooms (1911) 77; Kauffman, Agaricaceae of Mich. 1 (1918) 625; Brown, Minor Philip. Forest Products 3 (1921) 183; Rea, Brit. Basidiomycetae (1922) 64; Ramsbottom, Hdbk. Larger Brit. Fung. (1923) 28; Krieger, N. Y. Ste. Mus. Hdbk. 11 (1935) 359.

Pileus scaly from breaking up of cuticle, rarely smooth, often white, sometimes tinged yellow, red, or brown. Stem central, stuffed, easily separable from pileus, soft, fleshy, or firm. Gills white, sometimes changing color in age or when bruised or covered by green mass of spores; usually free, very rarely adnate or adnexed. Volva lacking, veil present, forming a ring on stem. Annulus persistent, easily disappearing in many species; cottony or fibrillose. Spores white except in *L. chlorospora*, where they are greenish in mass, and varying in shape, usually somewhat long, nearly spindle-shaped, elliptical, or ovate.

Taste mild. Many species are edible, a few are poisonous or mildly poisonous. The species are large or small, fleshy, firm or soft, not reviving when wet. Growing on the ground, especially manured ground, on debris, or on disintegrated wood in forests.

Key to the Philippine species of Lepiota.

a^1. Spore print in mass greenish .... 3. *L. morgani.*
a^2. Spore print in mass white.
  b^1. Plants caespitose .... 2. *L. cepaestipes.*
  b^2. Plants not caespitose.
    c^1. When bruised entire plant turns pinkish to reddish brown.
      d^1. Stem stout; pileus slightly umbonate .... 4. *L. americana.*
      d^2. Stem slender, pileus strongly umbonate .... 1. *L. philippinensis.*
    c^2. When bruised entire plant turns brown to dark brown.
      d^1. Pileus floccose .... 7. *L. candida.*
      d^2. Pileus powdery .... 12. *L. gracilenta.*
      d^3. Pileus warty .... 10. *L. hispida.*
      d^4. Pileus scaly.
        e^1. Scales yellow.
          f^1. Spores elliptic .... 8. *L. denundata.*
          f^2. Spores elongate .... 9. *L. metulispora.*
        e^2. Scales reddish brown .... 5. *L. cristata.*
        e^3. Scales violet-purple .... 6. *L. lilacea.*
        e^4. Scales wood brown .... 11. *L. meleagris.*

LEPIOTA PHILIPPINENSIS Mendoza sp. nov. Plate I, figs. 1 and 2.

Praedita est haec species: pileo primum ovato, posthac instar umbonis, campanulato, plano, quasi albi coloris, cuti operto, qui se convertit in squamas crassas atque separabiles, 5 cm ad 12 cm latas, sed ad marginem portat fibrillas; stipite farto, subfusco, squamis parvis ac quasi fusci coloris tecto, ad basem bulboso, 6 cm ad 15 cm × 9 mm ad 13 mm in diametro qui gradatim se minuit ad 4 mm ad 7 mm supra annulum; lamellis coartatis, mollibus, ventriosis, nonaffixis, a stipite segregatis collo cartilagineo; annulo crasso atque mobili; carne crassa, alba et floccosa; sporis hyalinis; ellipticis, glabris, 6.6 ad 9.6 μ × 3 ad 5.4 μ; basidiis clavitis, 15 ad 21 μ × 3.5 ad 4.5 μ.

Pileus 5 to 12 cm in diameter, whitish, covered with Mikado brown[1] cuticle which breaks up into thick separable scales; ovate, acorn-shaped, later campanulate and flattened, with a broad, prominent, conical umbo; margin covered with small fibrils. Stem whitish to brownish, surface layer breaking up into small brownish scales, covered with delicate, long, fine fibers, 6 to 15 cm long, 9 to 13 mm in diameter at the base, above ring 4 to 7 mm in diameter, slender, tapering upward from a bulb. Gills ventricose, crowded, soft, often becoming fuscous at edge; free, separated by a cartilaginous collar from stem. Flesh thick, white, floccose. Annulus thick, movable, white above, brownish exteriorly. Spores hyaline, smooth, elliptic, 6.6 to 9.6 μ long, 3.0 to 5.4 μ broad; average 8.4 μ long, 5.3 μ broad. Basidia clavate, 15 to 21 μ long, 3.5 to 4.5 μ broad.

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[1] The color nomenclature is based on Ridgway's Color Standards and Color Nomenclature, Washington, D. C. (1912).

On the ground and under trees; very common during wet season from June to September.

LUZON, Manila, *Philip. Nat. Herb. 1086 P. S. Gener,* May 17, 1934; *Philip. Nat. Herb. 1272 P. S. Gener,* May 21, 1934, on the ground; *Philip. Nat. Herb. 1285 P. S. Gener,* May 22, 1934, on the ground; *Philip. Nat. Herb. 1286 P. S. Gener,* May 24, 1934, on the ground; *Philip. Nat. Herb. 2068 P. S. Gener,* September 12, 1934, on the ground; *Philip. Nat. Herb. 2352 Jesus Conosa,* May 10, 1935, on the ground; *Philip. Nat. Herb. 2353 P. S. Gener,* May 9, 1935; *Philip. Nat. Herb. 2402 P. S. Gener,* May 24, 1935, on the ground; *Philip. Nat. Herb. 2416 P. S. Gener,* May 27, 1935, on horse dung; *Philip. Nat. Herb. 2490 P. S. Gener,* July 6, 1935, on the ground; *Philip. Nat. Herb. 2491 J. M. Mendoza,* July 12, 1935, on the ground; *Philip. Nat. Herb. 2543 P. S. Gener,* July 23, 1935, on the ground; *Bur. Sci. 55103 J. M. Mendoza* (type in Philip. Nat. Herb.), September 8, 1933, on the ground; *Bur. Sci. 55116 J. M. Mendoza,* July 29, 1933, on the ground; *Bur. Sci. 55125 P. S. Gener,* August 20, 1933, on the ground; *Bur. Sci. 55149 J. M. Mendoza,* July 10, 1933, on the ground; *Bur. Sci. 55160 J. M. Mendoza,* July 2, 1933, on the ground; *Bur. Sci. 55585 P. S. Gener,* October 16, 1933, on the ground.

The above-examined specimens are similar to *Lepiota procera* from the United States and one specimen from Hungary in general appearance, in form, and in the color and arrangement of scales. The two extra-Philippine species, however, are very much larger. *Lepiota procera* differs largely from the present species in having the spores and the basidia much larger; the former are 10.5 to 15.0 μ long and 8.4 to 11.4 μ broad (Plate 1, fig. 3), and the latter 30.0 to 36.0 μ long and 9.9 to 12.0 μ broad.

2. LEPIOTA CEPAESTIPES Fries. Plate 2.

Lepiota cepaestipes FRIES in Epicrisis (1836) 17; BERKELEY & BROOME, Journ. Linn. Soc. 19 (1871) 499; SACC., Syll. Fung. 5 (1887) 43; COOKE, Hdbk. of Australian Fung. (1892) 9; MASSEE, Brit. Fungus-Flora 3 (1893) 246; GRAFF, Philip. Journ. Sci. 19 (1914) 243; KAUFFMAN, Agaricaceae of Mich. 1 (1918) 640; REA, Brit. Basidiomycetae (1922) 74; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 30; MENDOZA & LEUS-PALO, Philip. Journ. Sci. 58 (1935) 496; KRIEGER, N. Y. Ste. Mus. Hdbk. 11 (1935) 37).

Lepiota manilensis COPELAND in Bur. Govt. Lab. Publ. 28 (1905) 145.

Pileus 3 to 9 cm in diameter; white or yellowish; mealy or covered with yellowish, floccose or wartlike scales; umbonate, oval, then campanulate-expanded; obtuse, soft, fleshy, striated on margin, splitting in age. Stem white, pale brown in early or late part of mushroom season, otherwise of same color as cap; base bulbous, somewhat ventricose, tapering upward and occasionally covered with floccose particles, hollow, 5 to 14 cm long, 5.0 to 8.0 mm thick at apex. Annulus thin, membranaceous, somewhat persistent. Gills free, thin, narrow, at length remote; edge pruinose. Spores elliptic to ovate, hyaline, granular, guttulate, smooth-walled, varying in size from 8.4 to 12.0 µ long, 6.0 to 9.0 µ broad; average 10.0 µ long, 7.0 µ broad. Basidia clavate, 29.0 to 46.0 µ long, 11.4 to 13.5 µ broad; average 30.0 µ long, 12.7 µ broad.

Growing in tufts on decayed leaves under trees and very common during the wet season, from May or April, although occasionally found in February when the rainy season is prolonged.

LUZON, Laguna Province, Los Baños, *Philip. Nat. Herb. 2094 J. M. Mendoza*, October, 1932; Mount Maquiling, *Bur. Sci. 55671 J. M. Mendoza*, December 23, 1932, on the ground; Manila, *Philip. Nat. Herb. 519 Jesus Conosa*, January 15, 1931, on the ground; *Philip. Nat. Herb. 2540 B. Reyes*, July 24, 1935; *Philip. Nat. Herb. 2544 P. S. Gener*, July 11, 1935, on the ground; *Bur. Sci. 21325 P. W. Graff* (*Lepiota manilensis* Copel. as determined by Graff), July 30, 1913; *Bur. Sci. 50495 S. Leus*, June 21, 1928, on the ground; *Bur. Sci. 50496 B. Reyes*, August, 1928, on the ground; *Bur. Sci. 55056 J. M. Mendoza*, July 8, 1933, on the ground; *Bur. Sci. 55117 J. M. Mendoza*, August 1, 1933, on the ground; *Bur. Sci. 55121 J. M. Mendoza*, July 22, 1933, on the ground; *Bur. Sci. 55122, 55123, and 55127 P. S. Gener*, September 20, 1933, on the ground; *Bur. Sci. 55135 and 55142, J. M. Mendoza*, July 10, 1933, on the ground; *Bur. Sci. 55147 J. M. Mendoza*, June 29, 1933, on the ground; *Bur. Sci. 55157, 55158, and 55161, J. M. Mendoza*, July 11, 1933, on the ground; *Bur. Sci. 55207 J. M. Mendoza*, July 26, 1933, on the ground; *Bur. Sci. 55296 D. Farol*, June 3, 1933; *Bur. Sci. 55602 P. S. Gener*, October 12, 1932, on the ground; *Bur. Sci. 55611 J. M. Mendoza*, September 19, 1933; *Bur. Sci. 55687 J. M. Mendoza*, June 22, 1933, on the ground; *Bur. Sci. 55758 J. M. Mendoza*, February 21, 1933, on the ground; *Bur. Sci. 55769 and 55771 P. S. Gener*, November 7, 1933, on the ground; *Bur. Sci. 55770 P. S. Gener*, November 8, 1933, on the ground; *Bur. Sci. 55824 P. S. Gener*, October 13, 1933; *Bur. Sci. 55874 J. M. Mendoza*, October 2, 1932, on the ground; *Bur. Sci. 55915 P. S. Gener*, December 20, 1933, on the ground: Rizal Province, Pasay, *Bur. Sci. 55146 J. M. Mendoza*, July 7, 1933, on the ground; *Bur. Sci. 55151 J. M. Mendoza*, July 29, 1933, on the ground; *Bur. Sci. 55558 J. M. Mendoza*, May 20, 1933; *Bur. Sci. 55670 J. M. Mendoza*, May 23, 1932; *Bur. Sci. 55727 J. M. Mendoza*, June 17, 1933, on the ground: Tayabas Province, Atimonan, *Bur. Sci. 55105 J. M. Mendoza*, June 22, 1933, on the ground; *Bur. Sci. 55144 J. M. Mendoza.*

All the above Philippine specimens were found identical in their characters with the United States collection of Edward C. Valkart, Cincinnati, Ohio, September 5, 1922 (New York Botanical Garden, Mycological Herbarium). Copeland's specimen, *Lepiota manilensis*, tallies in all characteristics with *Lepiota cepaestipes* Fries.

4. LEPIOTA MORGANI Peck. Plate 4.

Lepiota morgani PECK in Bot. Gaz. 4 (1879) 167; SACC., Syll. Fung. 5 (1887) 31; HARD, Mushrooms (1908) 60; ATKINSON, Mushrooms (1911) 60; KAUFFMAN, The Agaricaceae of Mich. 1 (1918) 644; MCDOUGALL, Mushrooms (1925) 63; KRIEGER, N. Y. Ste. Mush. Hdbk. 11 (1935) 373.

Lepiota chlorospora COPELAND in Ann. Myc. 3 (1905) 28; Bur. Govt. Lab. Publ. 28 (1905) 145; BROWN, Minor Philip. Forest Products 3 (1921) 140.

Pileus 9 to 30 cm in diameter, at first nearly globose, soon becoming expanded, seldom depressed in middle, generally white, covered by a brown cuticle which breaks up into scales except at center, when bruised color changing to brownish, then to yellowish. Gills crowded, free, separated by a white collar from stem; at first white, soon becoming green or greenish. Stem 7 to 9 cm long, 5 to 9 mm wide, white or nearly so, tinged with brown; smooth, firm, cylindrical, swollen at base, sometimes tapering slightly upward. Annulus broad, conspicuous, fixed, persistent; at first white, later discolored by mass of green spores. Basidia clavate, granular, 24.0 to 30.0 μ long, 9.6 to 12.0 μ broad. Spores in mass green, becoming yellowish in age, hyaline-green under microscope, 9.0 to 9.6 μ long, 6.0 to 6.6 μ broad.

LUZON, Bataan Province, Lamao, *Bur. Sci. 55115, J. M. Mendoza*, September 10, 1933, on heavily fertilized sandy soil; *Bur. Sci. 55188 J. M. Mendoza*, September 12, 1933, on the ground; *Bur. Sci. 55859 J. M. Mendoza*, September 11, 1933, on the ground; *Bur. Sci. 55892 J. M. Mendoza*, September 11, 1933, on sandy soil near beach: Laguna Province, *Bur. Sci. 55601 J. M. Mendoza*, December 9, 1932, on the ground; Agricultural College, *Bur. Sci. 55615 J. M. Mendoza*, July 21, 1932, on the ground; Los Baños, *Bur. Sci. 55790 E. Roldan*, July 14, 1932, on the ground; *Bur. Sci. 55796 E. Roldan*, August, 1931, on the ground; Manila, *Bur. Sci. (no number) E. R. Schreiner*, August 27, 1914 (This specimen according to Copeland is *Lepiota chlorospora*); *Philip. Nat. Herb. 508 P. S. Gener*, July 29, 1933, on the ground; *Philip. Nat. Herb. 526 and 527 P. S. Gener*, August 9, 1934, on the ground; *Philip. Nat. Herb. 1273 P. S. Gener*, May 21, 1934, on the ground; *Philip. Nat. Herb. 2413 P. S. Gener*, May 16, 1935, on the ground; *Bur. Sci. 45176 Father Sanchez*, May, 1935; *Bur. Sci. 50497 C. J. Humphrey*, November, 1926, on the ground; *Bur. Sci. 50546 Father Sanchez*, July 28, 1926; *Bur. Sci. 55091 P. S. Gener*, July 20, 1933, on the ground; *Bur. Sci. 55092 J. M. Mendoza*, September 21, 1933, on the ground; *Bur. Sci. 55124 P. S. Gener*, September 23, 1933, on the ground; *Bur. Sci. 55148 P. S. Gener*, September 18, 1933, on the ground; *Bur. Sci. 55204 J. M. Mendoza*, July 26, 1933, on the ground; *Bur. Sci. 55614 P. S. Gener*, September 16, 1933, on the ground; *Bur. Sci. 55669 H. S. Yates*, June 17, 1917, on the ground; *Bur. Sci. 55770 and 55843 P. S. Gener*, November 7, 1933, on the ground: Rizal Province, San Francisco del Monte, *Bur. Sci. 55668 J. M. Mendoza*, June 15, 1933, on the ground; San Juan, *Philip. Nat. Herb. 2422 F. Franco*, May 29, 1933, on horse manure; San Pedro Makati, *Bur. Sci. 55104 J. M. Mendoza*, September 12, 1932, on the ground; *Bur. Sci. 55120 J. M. Mendoza*, September 13, 1933, on the ground; *Bur. Sci. 55638 J. M. Mendoza*, September 12, 1932, on the ground; *Bur. Sci. 55666 E. Karganilla*, July 28, 1933, on the ground: Tayabas Province, Atimonan, *Bur. Sci. 55102 J. M. Mendoza*, June 22, 1933; Calauag, *Bur. Sci. 50742 Philip. Health Service Officer*, August 8, 1931, on the ground.

The above specimens are identical in their characters with *Lepiota morgani*, a collection of W. E. Broadway, St. George's, August 24, 1905, Plants of Granada, West Indies (New York Botanic Gardens, Mycological Herbarium).

The most outstanding feature of *Lepiota morgani* Peck (*Lepiota chlorospora* Copel.) is that the spores at maturity become greenish in mass. *Lepiota chlorospora* is doubtless *Lepiota morgani* Peck, so that the former becomes a synonym of the latter.

4. LEPIOTA AMERICANA Peck. Plate 6, fig. 1.

Lepiota americana PECK in N. Y. Ste. Cab. Rept. 23 (1872) 71; SACC., Syll. Fung. 5 (1887) 43; ATKINSON, Mushrooms (1911) 80; MURRILL, Mycologia 3 (1911) 168; KAUFFMANN, The Agaricaceae of Mich. 1 (1918) 648; GRAHAM, Chicago Acad. Sciences 4 (1933) 48; MENDOZA & LEUS-PALO, Philip. Journ. Sci. 53 (1931) 223; KRIEGER, N. Y. Ste. Mus. Hdbk. 11 (1935) 370.
Agaricus boltoni COPELAND in Bur. Govt. Lab. Publ. 28 (1905) 144; BROWN, Minor Philip. Forest Products 3 (1921) 132.

Pileus 5 to 14 cm in diameter; white, becoming dark brown on maturity; convex, conical, umbonate to subumbonate at maturity, cuticle at first reddish brown, soon breaking into scales except at umbo; scales scattered, appressed; margin striate, laciniate, when bruised entire plant turning pinkish to reddish brown. Gills free, white, broad, 7 to 9 mm wide. Stipe hollow, white, becoming brown in age, enlarged at base, slender above ring, 7 to 10 mm in diameter. Annulus broad, very conspicuous, 1.3 to 2.2 cm wide, 1.6 to 2.5 cm from pileus. Basidia clavate, bearing 4 slender sterigmata, 18 to 30 μ long, 8.4 to 10.5 μ broad; average 24.5 μ long, 9.1 μ wide. Spores subellipsoid, guttulate, smooth, hyaline, 8.5 to 10.5 μ long, 5.0 to 7.2 μ broad; average 9.9 μ long, 6.25 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 1289 P. S. Gener*, May 21, 1934, on the ground; *Philip. Nat. Herb. 1304 P. S. Gener*, June 14, 1934, on the ground; Pandacan, *Philip. Nat. Herb. 517 P. S. Gener & B. Reyes*, October 28, 1933, on the ground; *Philip. Nat. Herb. 1334 P. S. Gener & F. B. Sangalang*, June 2, 1933, on the ground; *Philip. Nat. Herb. 1896 P. S. Gener*, July 26, 1934, on the ground; *Bur. Sci. 55119 J. M. Mendoza*, July 29, 1933, on the ground; *Bur. Sci. 55197 and 55189 J. M. Mendoza*, July 24, 1933, on the ground; *Bur. Sci. 55209 J. M. Mendoza*, July 25, 1933, on the ground; *Bur. Sci. 55587 J. M. Mendoza*, August 1, 1933, on the ground; *Bur. Sci. 55735 J. M. Mendoza*, February 2, 1933, on the ground; *Bur. Sci. 55768 and 55842 P. S. Gener*, November 7, 1933, on the ground. MINDANAO, Davao Province, *E. B. Copeland 433*, April, 1904 (type collection of *A. boltoni* Copel. in Philip. Nat. Herb.).

In shape this species resembles a poisonous species, *L. morgani* Peck., particularly in the button stage. *Lepiota morgani*, however, has green spores, making the gills look greenish.

The examined specimens are identical in their characters with a United States collection of Miss D. Levy, vicinity of New York (New York Botanical Garden, Mycological Herbarium).

In the type collection of *Agaricus boltoni* Copel. the spores are white and subellipsoid. The presence of the white spores alone eliminates this species from the genus *Agaricus*, which is a purple-brown agaric. The distinctive shape and size of the spores which agree closely with those of *Lepiota americana* lead us to consider that these two species are the same. Another feature which confirms that *Agaricus boltoni* is *Lepiota americana* is the bulbous base of the former, which character is not lost even in the dried specimen.

8. LEPIOTA CRISTATA Fries. Plate 4, fig. 1.

> *Lepiota cristata* FRIES in Syst. Myc. (1821) 22; Hym. Eur. (1874) 32–33; SACC., Syll. Fung. 5 (1887) 39; MASSEE, Brit. Fungus-Flora 3 (1893) 242; ATKINSON, Mushrooms (1911) 81; KAUFFMAN, The Agaricaceae of Mich. 1 (1918) 641; REA, Brit. Basidiomycetae (1922) 71; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 30; MCDOUGALL, Mushrooms (1925) 65; MAUBLANC, Les Champ. Com. et Ven. (1926) 16; BRES., Icon. Mycol. 1 (1927) 34; SWANTON, Fung. and How to Know Them (1932) 177, 178.
>
> *Lepiota fusco-squamea* PECK in Rep. Ste. Mus. 5 (1873) 60; SACC., Syll. Fung. 5 (1887) 201; BROWN, Minor Philip. Forest Products 3 (1921) 140.

Pileus 3 to 6 cm in diameter, fleshy, silky, campanulate, then expanded, often umbonate; disc brown, covered with reddish-brown scales. Gills 3 to 5 cm long, 2 to 6 cm in diameter; white, plane, narrow, crowded, free toward center. Stipe fragile; white or yellowish below ring; hollow or stuffed; glabrous or silky fibrillose. Annulus narrow, somewhat membranaceous, distant, white, often tinged reddish, fugacious, disappearing. Gills free, plane, white, crowded. Spores hyaline, reniform, obliquely apiculate, 8.4 to 10.5 μ long, 3.3 to 5.4 μ broad. Basidia clavate, 16.5 to 19.5 μ long, 4.5 to 5.4 μ broad.

LUZON, Laguna Province, Los Baños, *Bur. Sci. 55635 J. M. Mendoza*, December 10, 1932, on the ground: Manila, *Philip. Nat. Herb. 1281 P. S. Gener*, May 25, 1934, on the ground; *Philip. Nat. Herb. 1284 P. S. Gener*, May 31, 1934, on the ground; *Philip. Nat. Herb. 1291 P. S. Gener*, May 22, 1934, on the ground; *Philip. Nat. Herb. 1299 P. S. Gener*, May 24, 1934, on the ground; *Philip. Nat. Herb. 2486 P. S. Gener*, June 1, 1935, on the ground; *Bur. Sci. 9170 E. D. Merrill*, July 24, 1913; *Bur. Sci. 55145 J. M. Mendoza*, July 6, 1933, on the ground; *Bur. Sci. 55780 J. M. Mendoza*, August 12, 1933, on the ground; Rizal Province, Alabang, *Philip. Nat. Herb. 2492 J. M. Mendoza*, July 12, 1935, on the ground.

The distinctive reddish-brown scales of *Lepiota fusco-squamea* Peck, the umbonate character of the pileus, and the diminutive size of this species make it appear a synonym of *Lepiota cristata* Fries. Microscopical examination of spores and basidia of these two species proves that they both fall under the same size variation.

6. LEPIOTA LILACEA Bresadola. Plate 5, fig. 1.

Lepiota lilacea BRESADOLA in Sacc., Syll. Fung. 11 (1895) 3; BRES., Icon. Mycol. 1 (1927) 39.

Pileus fleshy, 2 to 4 cm in diameter; convex-campanulate, expanded, depressed at center, sometimes umbonate; at first violet-purple, later discolored; cuticle breaking up into beautiful dark scales. Gills white, somewhat crowded, inflated on one side, round and free toward center, adpressed at fringed edge. Stem hollow, fibrous, somewhat covered with powdery scales, becoming smooth, white, flesh-colored to violet, 3 to 5 cm long, 3 to 5 mm in diameter. Annulus membranaceous, inferior, persistent, white above, dark violet below. Flesh white, odorless, tasteless. Spores hyaline, elliptic, 6.0 to 6.6 μ long, 3 to 3.6 μ broad. Basidia clavate, 21 to 24 μ long, 6.6 to 9 μ broad.

LUZON, Laguna Province, Los Baños, *Philip. Nat. Herb. 2078 and 2093 J. M. Mendoza*, December, 1932: Manila, *Philip. Nat. Herb. 509 P. S. Gener*, February 3, 1934; *Philip. Nat. Herb. 1267 P. S. Gener*, January 17, 1934, on the ground; *Philip. Nat. Herb. 1282 P. S. Gener*, May 23, 1934, on the ground; *Bur. Sci. 55118 P. S. Gener*, September 23, 1933, on the ground; *Bur. Sci. 55563 P. S. Gener*, October 9, 1933, on the ground; *Bur. Sci. 55845 P. S. Gener*, November 8, 1933, on the ground; *Bur Sci. 55917 P. S. Gener*, December 16, 1933, on the ground; *Bur. Sci. 55926 P. S. Gener*, December 21, 1933, on the ground: Rizal Province, Alabang, *Philip. Nat. Herb. 2526 J. M. Mendoza*, July 24, 1935, on the ground under acacia, *Samanea saman* (Jacq.) Merr.

7. LEPIOTA CANDIDA Copeland. Plate 5, fig. 2.

Lepiota candida COPELAND (not *L. candida* Morgan) in Bur. Govt. Lab. Publ. 28 (1905) 146; BROWN, Minor Philip. Forest Products 3 (1921) 202.

Lepiota pulcherrima (Morg.) GRAFF in Philip. Journ. Sci. 9 (1914) 244.

Pileus at first ovate, then conical, umbonate, flat in age; snow white, 4.0 to 5.0 cm in diameter; when young covered with fine to coarse scales, soon disappearing. Stipe 9 to 10 cm long, 5.0

to 7.0 mm in diameter; same color as pileus; covered with evanescent scales; cylindric, not bulbous, gradually tapering into narrower diameter as it approaches pileus. Annulus white, floccose, thin, high up, early disappearing. Gills free, thin, white, crowded, close, nearly acute at both ends. Flesh white, odorless; taste mild. Spores elliptical, cylindrically apiculate at one end, with a pinkish tinge at a certain focus of the microscope; 7.5 to 9.6 µ long, 5.4 to 6.5 µ broad. Basidia clavate, 15.0 to 18.0 µ long, 3.6 to 5.1 µ broad.

LUZON, Bataan Province, Lamao, *Bur. Sci. 55909 J. M. Mendoza*, September 11, 1933, on the ground: Manila, *Bur. Sci. 56 Father Sanchez*, September, 1913 [type collection of *Lepiota pulcherrima* (Morg.) Graff in Philip. Nat. Herb.]; *Philip. Nat. Herb. 1322 and 1339 P. S. Gener*, May 24, 1934, on the ground; *Philip. Nat. Herb. 1324 P. S. Gener*, May 22, 1934, on the ground; *Philip. Nat. Herb. 2382 P. S. Gener*, May 16, 1935, on the ground: *Phil. Nat. Herb. 2521 T. G. Fajardo*, July 17, 1935, on adobe wall; *Bur. Sci. 25386 H. S. Yates*, June 27, 1916, on decaying leaves and twigs; *Bur. Sci. 55176 J. M. Mendoza*, September 12, 1933, on the ground: Rizal Province, Pasay, *Philip. Nat. Herb. 2591 Bureau of Health Officer*, May 23, 1934, on the ground: Tayabas Province, Atimonan, *Bur. Sci. 55156 J. M. Mendoza*, June 23, 1933, on the ground.

The white appearance is the most striking character of *Lepiota candida* Copel. and *Lepiota pulcherrima* (Morg.) Graff. The characteristic fusiform lower third of the stipe, however, and the spore measurements of these two species show that they are synonymous. Copeland was first to describe this species; the name he gave to it is very descriptive of the fungus, and we retain it in this paper, leaving *Lepiota pulcherrima* (Morg.) Graff as a synonym.

6. LEPIOTA DENUDATA Rabenhorst. Plate 6, fig. 1.

Lepiota denudata RABENHORST in Exs. (1853) 1006; FR., Hym. Eur. (1874) 38; SACC., Syll. Fung. 5 (1887) 52; BRES., Icon. Mycol. 1 (1927) 40.

Lepiota sulphopenita GRAFF, Philip. Journ. Sci. 9 (1914) 245.

Pileus globose to conical when young, becoming campanulate to broadly expanded; generally sulphur-yellow throughout; thin, fleshy, 4 to 7 cm in diameter; sometimes center of cap mealy orange, covered with fine floccose scales which disappear in age; margin deeply striated especially when old. Gills free, thin, narrow, few, white, becoming yellowish because of scales from the cap adhering to them. Stem hollow, floccose, cylindrical, elongated at base, sulphur-yellow, 7 to 10 cm long, 6 to 11 mm broad. Annulus thin and early disappearing. Spores ovate-elliptic, hyaline, guttulate, smooth-walled, 7.5 to 9.6 μ long, 5.4 to 6.3 μ broad. Basidia clavate, granular, 15 to 18.6 μ long, 3.6 to 4.5 μ broad.

LUZON, Bataan Province, Lamao, *Bur. Sci. 55732 J. M. Mendoza*, September 10, 1933, on the ground: Manila, *Philip. Nat. Herb. 1283 P. S. Gener*, May 28, 1934, on disintegrated trunk of palms; *Philip. Nat. Herb. 2017 P. S. Gener*, September 12, 1934, on the trunk of a living tree; *Philip. Nat. Herb. 2381 P. S. Gener*, May 13, 1935; *Philip. Nat. Herb. 2542 P. S. Gener*, July 23, 1935, on the ground; *Bur. Sci. 8417 E. D. Merrill*, August 18, 1912 (type collection of *Lepiota sulphopenita* Graff in Philip. Nat. Herb.); *Bur. Sci. 55825 J. M. Mendoza*, August 31, 1933, on the ground; *Bur. Sci. 55826 P. S. Gener*, October 8, 1933, on the ground: Rizal Province, Pasay, *Philip. Nat. Herb. 1547 Bur. of Health*, May 23, 1934, on disintegrated wood; Harrison Park, *Philip. Nat. Herb. 2121 Bur. of Health Officer*, May 23, 1934, on ground: Tayabas Province, Atimonan, *Bur. Sci. 55140 J. M. Mendoza*, June 23, 1933, on the ground.

Our studies on the two fungi show that *Lepiota denundata* and *L. sulphopenita* are identical in their characters and probably the same species. The sulphur-yellow color of the entire fungus and the campanulate pileus are the characteristics common in the two species. Spores and basidia are also alike. The difference in size, *L. denundata* Rabenh. being smaller than *L. sulphopenita* Graff, does not warrant calling the latter fungus a new species, as environment and nature of compost where a fungus grows may affect its size.

9. LEPIOTA METULISPORA Berkeley and Broome. Plate 6, fig. 1.

Lepiota metulispora BERKELEY & BROOME in Journ. Linn. Soc. 11 (1871) 512; FR., Hym. Eur. (1874) 32; SACC., Syll. Fung. 5 (1887) 38; MORGAN, Journ. Myc. 12 (1906) 198; BRES., Icon. Mycol. 1 (1927) 40.

Pileus 4 to 7 cm in diameter; fleshy, campanulate-expanded, swollen to broadly umbonate, covered with lemon-yellow to tawny-colored scales; center smooth. Gills white, crowded, free, rounded toward the stem, close. Stem 4 to 9 cm long, 5 to 9 mm in diameter, hollow, white, covered below ring with tawny to lemon-colored scales. Annulus cottony, later disappearing. Flesh white like that of pileus, a little darker, of fungous odor and mild taste. Spores hyaline, elongated, flexuous, 15.6 to

18.0 μ long, 4.5 to 5.7 μ broad. Basidia clavate, 18.0 to 21.0 μ long, 6.0 to 8.4 μ broad.

LUZON, Manila, *Philip. Nat. Herb. 1344 Jesus Conosa*, February 12, 1934; *Philip. Nat. Herb. 2042 P. S. Gener*, September 6, 1934, on the ground; *Philip Nat. Herb. 2433*, June 1, 1935, on the ground; *Philip. Nat. Herb. 2488 P. S. Gener*, July 3, 1935, on the ground; *Philip. Nat. Herb. 2520 P. S. Gener*, July 10, 1935, on the ground; *Philip. Nat. Herb. 2538 P. S. Gener*, July 6, 1935, on the ground; *Philip. Nat. Herb. 2541 P. S. Gener*, July 23, 1935.

10. LEPIOTA HISPIDA Lasch. Plate 7, fig. 1.

> *Lepiota hispida* LASCH in Fr., Hym. Eur. (1874) 32; SACC., Syll. Fung. 5 (1887) 36; MASSEE, Brit. Fungus-Flora 3 (1893) 240; REA, Brit. Basidiomycetae (1922) 67, 68; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 30; BRES., Icon. Mycol. 1 (1927) 28.

Pileus 3 to 8 cm in diameter; soft, fleshy; chestnut-brown to brown; hemispherical, then expanded, umbonate; covered with shaggy scales which are denser at center than around margin. Stem 4 to 9 cm long, 4 to 12 mm in diameter, cylindrical, more or less bulbous at base, tapering upward, scaly, of same color as pileus. Annulus broad, superior, white-rose above, tawny below, striated. Gills white, crowded, free toward the stem, linear, branched, often veined. Flesh white, thin; of mushroom odor, no taste. Spores hyaline, elliptic, 6 to 7 μ long, 2 to 3 μ broad. Basidia clavate, 25 to 28 μ long, 6 to 7 μ broad.

LUZON, Mountain Province, Haights' Place, *Philip. Nat. Herb. 2008 C. J. Humphrey*, May 4, 1935, on dead log.

11. LEPIOTA MELEAGRIS Sowerby. Plate 7, fig. 2.

> *Lepiota meleagris* SOWERBY in Fr., Hym. Eur. (1874) 31; SACC., Syll. Fung. 5 (1877) 30; MASSEE, Brit. Fungus-Flora 3 (1893) 239; REA, Brit. Basidiomycetae (1922) 68; RAMSBOTTOM, Hdbk. Larger Brit. Fung. (1923) 29; BRES., Icon. Myc. 1 (1927) 29.

Pileus fleshy, conical-campanulate when young, becoming umbonate when expanded; 1 to 3 cm in diameter; fawn-colored, covered with minute brownish scales; margin becoming smooth. Gills crowded, white to flesh-colored, becoming reddish on rubbing or drying; free and round toward stem, separated from stem, with a cartilaginous collar. Stem stuffed, of same color as pileus, here and there tinged with yellow, covered with minute scales below ring, spindlelike or tapering upward from bulbous base. Ring white, easily disappearing, outside often covered with minute blackish scales. Flesh white, tawny red when

THE DIWAL FISHERY OF OCCIDENTAL NEGROS

By GUILLERMO L. ABLAN

Of the Fish and Game Administration, Bureau of Science, Manila

TWO PLATES

The investigation of the diwal fisheries of Occidental Negros was undertaken in accordance with the industrialization plan of the Bureau of Science. Observations were made during a season of rough weather and heavy rains; consequently, because of unfavorable circumstances, the period of a little more than one month allowed for the study was not fully utilized. This report includes field observations and information obtained from shell diggers, consumers, and government officials regarding the fishery.

The diwal has a limited distribution. The Marayo diwal bed in the jurisdiction of Pontevedra, where this bivalve is most abundant in this locality, was selected for observation. Pontevedra, established about 1877 or 1878, is now a second-class municipality, with a population of 14,000 and an area of 23,178 hectares. It is located along the coast bordering Guimaras Strait, well protected from the west by Panay and Guimaras Islands, and drained by Marayo River which empties into Guimaras Strait. Numerous varieties of shells embedded in the soil are evidence that this place was at one time below sea level.

In gathering information regarding the various factors influencing demand and consumption, local consumers, including diggers and government officials, were interviewed. The diwal is locally considered the most healthful and delicious among the shell foods found in this locality, not excepting the oyster. It is of good flavor, either raw or prepared, and has a large amount of meat compared with other bivalves. Therefore the diwal is in great demand, not only in the local markets but also in other markets of the Philippines.

In this locality four factors, the influence of the incoming sea water passing between points of Sojoton and South, the effect of river discharge, the type of soil, and the location, were studied.

The Marayo diwal bed is located at the mouth of Marayo River, along the coast from Balangigay point on the south approximately 1 kilometer, and to the north about 50 meters, from the mouth of the river. This portion of the shore has been a productive diwal ground for almost half a century. It has an area of approximately 20 hectares, being 1,000 meters long and 200 meters wide.

The salinity of the water decreases between the diwal bed and the mouth of the river. The incoming salt water mixes in this section with the fresh water from the river.

The soil in this section, including adjacent deeper areas, is sticky, soft, fine sand and clay, blanketed with a layer of fine silt. The incoming and outgoing tidal current seem moderate.

In shape the diwal (*Pholas orientalis* Gmelin) (Plate 1, fig. 3), looks more or less like a corncob. The two valves are alike, and are crowned with a loose spoonlike shell with a prominent subanterior nucleus. The valves are laminate with rasplike ribs which radiate in rows from dorsal to ventral. The shell is open at both ends. The interior of the shell is usually whitish. The meat is soft, and, except the rather rough siphon, is edible even raw. The truncate foot is short and large, and can be expanded beyond the valves. The siphon (Plate 1, figs. 1 and 2) is a large, long, cylindrical tube ciliated at the end. It is a sensitive, muscular, and protrusible tubular organ, having two openings, the ventral, through which water containing diatoms, protozoa, and organic matter are drawn in, and the dorsal, through which waste materials are spouted out. The extension of the retracted siphon of the diwal may be induced by pouring water over the anterior side of the foot. Table 1 shows the length of the siphon in two specimens.

TABLE 1.—*Approximate length of siphon of diwal.*

Depth of burrow.	Size of diwal.		Length of siphon, extended.
	Length.	Circumference.	
Inches.	*Inches.*	*Inches.*	*Inches.*
15.5	4.5	4.5	7.5
17.5	4.11	4.5	7.0

After being extracted from its lodge and dropped into the water, the mollusk has never been observed to burrow its way into the ground under water. Diwal placed in a box filled with

ILLUSTRATION

PLATE 1. *Orectolobus japonicus* Müller and Henle.

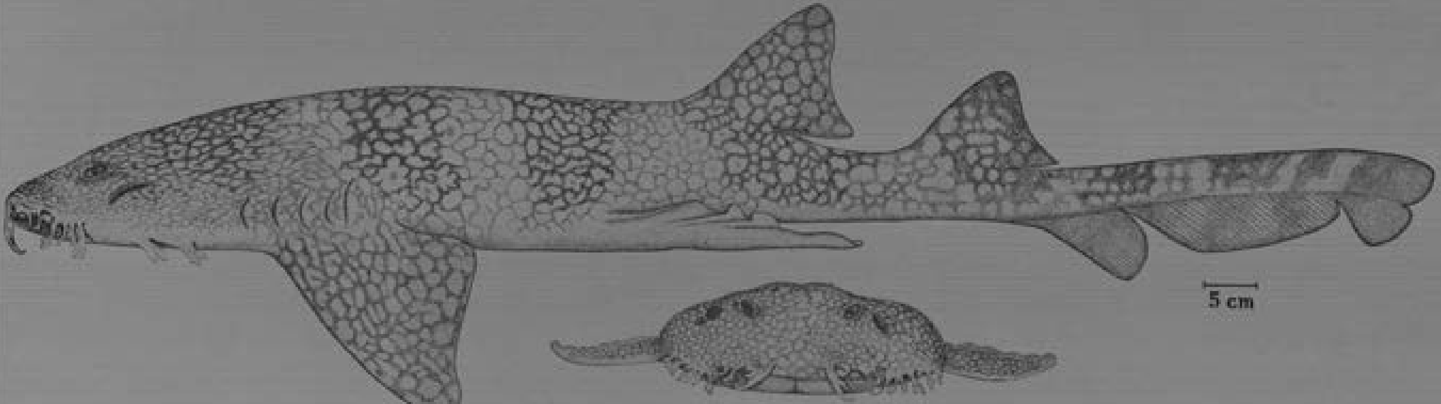

PLATE 1. ORECTOLOBUS JAPONICUS MÜLLER AND HENLE.

soil from the ground of their own habitat were not noticed to burrow.

DISTRIBUTION OF DIWAL IN MARAYO

Diwal in their own habitat live buried, vertically or horizontally, to a depth of from less than a foot to about 2 feet. Table 2 shows the size of a number of burrows found.

TABLE 2.—*Size of burrows of diwal.*

Specimens.	Distance between holes.	Burrow.	
		Position.	Depth or length.
	Inches.		*Inches.*
1		Vertical	9.0
1		do	11.5
1		Horizontal	12.0
1		do	17.0
1		do	17.0
2	1	do	19.0
2	3	do	16.0
1		do	21.0
2	7	do	17.0
1		do	22.0
1		do	20.0
14			

Diwal commonly occur singly in a burrow and are revealed by slits or holes which the animals form on the surface of the ground. In cases where they are abundant they sometimes form groups called *pagahan*, similar to the hive nest of the white ants.

Digging out such colonies one may include several others, due to the softness of the soil of their habitat.

The irregular distribution of these mollusks in a given bit of ground, where they occur singly or in groups, may be due to biological causes in connection with certain stages of their life history.

METHODS OF GATHERING DIWAL

A digger's outfit consists of (*a*) *usoc*, (*b*) *antipara*, (*c*) *guantes*, (*d*) *pu-yo*, (*e*) *tagad*, and (*f*) *baroto*.

The usoc is a bamboo or wooden pole about 5 or 8 centimeters in diameter and 4 to 5 meters long. It is an indispensable device for the digger to hold on to while working under water or while he is resting on the surface.

The antipara is a pair of water-proof eyeglasses to enable the digger to open his eyes under water, in order to determine the location of mollusks without subjecting his eyes to undue strain.

The guantes are made of cotton cloth, and fit individual fingers which they protect from sharp shells. They are held firmly at the bases with strong fine cotton twine which keeps them from slipping off.

The pu-yo is ordinarily a sack with a short rope tied to each corner of the opened top. The ropes serve as a belt to hold the sack for the shells.

The tagad is a paddle-shaped implement, of either iron or wood, with which to dig out the mollusk.

The baroto is a dugout used by the digger to go to and from the shell ground.

Whenever possible the diwal is dug with the hands. Where the soil is hard and the water deep, digging out the burrow of the mollusk is somewhat risky and complicated. Good weather and clear water are always necessary. Upon arrival at the ground, the baroto is anchored and the digger drives his usoc into the ground. After the goggles and sack are set, the digger plunges into the water to reach the pole. The pole is thrust into the ground and pulled up several times to test firmness; then the digger, holding the pole, goes down to the bottom feet first, to locate the holes of the mollusks.

Plate 2, figs. 1 and 2, show how the digger rests in relation to the pole and the position of the body during the digging, which mostly depends on the distance of a hole or holes from the pole.

The digger sticks an index finger into a slit, which disturbs the mollusk and causes it to withdraw its siphon and thus to reveal its position. The burrow is then dug out with one or both hands until the shell is reached. The shell is then held firmly between the thumb and the forefinger on both edges of the posterior side, to prevent the valves from breaking. When difficulty is encountered in extracting the shell, a twist is made, followed by a push and pull movement to loosen the mollusk from its burrow. One dive usually lasts about half a minute. The number of shells dug out in one dive depends on the abundance of shells, the types of soil, and the endurance of the digger.

In grounds where the soil is very hard, the tagad is indispensable. As soon as all burrows in one spot are dug out, the pole is moved to another place and the operation repeated.

While digging for diwal, diggers meet water snakes (*walo-walo*), sharks (*baguis*), and jelly fishes (*pitres*). The sting of

Medusæ of many varieties, kinds, forms, and sizes inflict severe pain which, in some cases, even results in illness. Their habit of drifting with the tide makes them a frequent menace to diggers. A victim from jellyfish sting is usually made to perspire profusely by placing him over steaming sea water and covering him with a thick blanket.

Water snakes and sharks, which are sometimes found in the locality, are enemies of the diwal, whose siphons if extended within the reach of the snakes or fish are lost.

STATUS OF THE DIWAL FISHERIES

A diwal bed has always served as a communal fishery ground open to all, a condition which has prevailed for about half a century, since the foundation of the municipality. Such an arrangement has attracted diggers from other localities to Pontevedra to take advantage of this fishery resource. There are no regulatory measures for the conservation of the species, and the digger may fish at all times, and collect and gather any size and any quantity of shells, and may use any device for digging.

There are no available records regarding the quantity and the value of this fishery resource. Diggers interviewed said that the diwal season is from March to the early part of June every year, and that the harvest from this bed was most abundant from 1926 to 1928. In those years each digger could gather not less than 500 shells daily, and there were as many as 50 diggers a day. The total daily collection of 25,000 shells, which were sold at 1.50 pesos[1] a hundred, would give a daily sale of 375 pesos. The annual harvest during this period on the basis of three months' operation was estimated at 33,750 pesos. Since then it has declined, until the present harvest is estimated to be around 8,000 pesos annually, which is only one-fourth that of the years of abundance.

MARKETING OF THE DIWAL

Diwals are marketed alive. In transporting them by trucks or sailing sampans, great care is always taken to keep them alive until they reach the market.

It has been found that shells placed in boxes filled with soil from the diwal ground kept moist with salt water can live for about 4 days.

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[1] One peso is equal to 50 cents United States currency.

Because of their high value in the locality and in other islands only a small portion of the shells gathered are sold for local consumption.

The diwal compared with other shells is meaty, and its meat is of a rich milky quality, which makes diwal soup rich and delicious. Table 3 shows the size and weight of 6 specimens.

TABLE 3.—*Size and weight of diwal.*

Specimen.	Shell.		Greatest thickness of body.	Weight.				
	Length.	Width.		Specimen.	Shell.		Meat.	
	cm.	cm.	cm.	g.	g.	Per cent.	g.	Per cent.
1	10.2	3.3	3.6	40.64	17.11	42	23.53	58
2	12.7	3.85	4.0	67.48	23.55	34	43.93	65
3	13.0	3.8	3.9	70.85	22.42	31	48.43	68
4	13.2	3.9	3.8	56.59	17.93	31	38.66	68
5	13.3	3.9	4.0	74.27	22.81	30	51.46	69
6	13.6	3.6	3.9	78.38	23.36	29	55.02	70
Total				388.21	127.18	197	261.03	398
Average				64.70	21.03	33	43.64	66

Table 3 shows that approximately 66 per cent of the mollusk is edible meat.

CONSERVATION OF THE DIWAL

The supply of diwal tends to diminish. Growing communities with increasing populations and industrial plants, such as sugar centrals and rice mills, which are close to Marayo River and its tributaries, are positive factors in bringing about depletion of the fishery if the latter remains unprotected.

For the protection and conservation of the diwal, which has a wide reputation in Philippine markets, methods of harvesting it and minimum size and quantity of shells taken should be established.

The effects of water pollution on any aquatic life, although of temporary nature, cannot be overestimated. Consequently, steps should be taken to safeguard the streams from any source of pollution, especially from Sugar Centrals. Conservation in the positive sense implies wise utilization without endangering the future supply.

The first attempt to transplant diwal was undertaken in connection with this investigation. About one hundred diwal shells were brought to Hinigaran Fish Farm August 15, 1937.

The shells were planted by burying less than a foot deep in the soft sticky mud on the river side. About a week later most of the diwal were found to be alive.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Pholas orientalis* (side view).
2. *Pholas orientalis* (open view).
3. *Pholas orientalis* (dorsal view).
4. *Pholas orientalis* (ventral view).

PLATE 2

FIG. 1. Digging of *Pholas orientalis* (one position).
2. Digging of *Pholas orientalis* (another position).

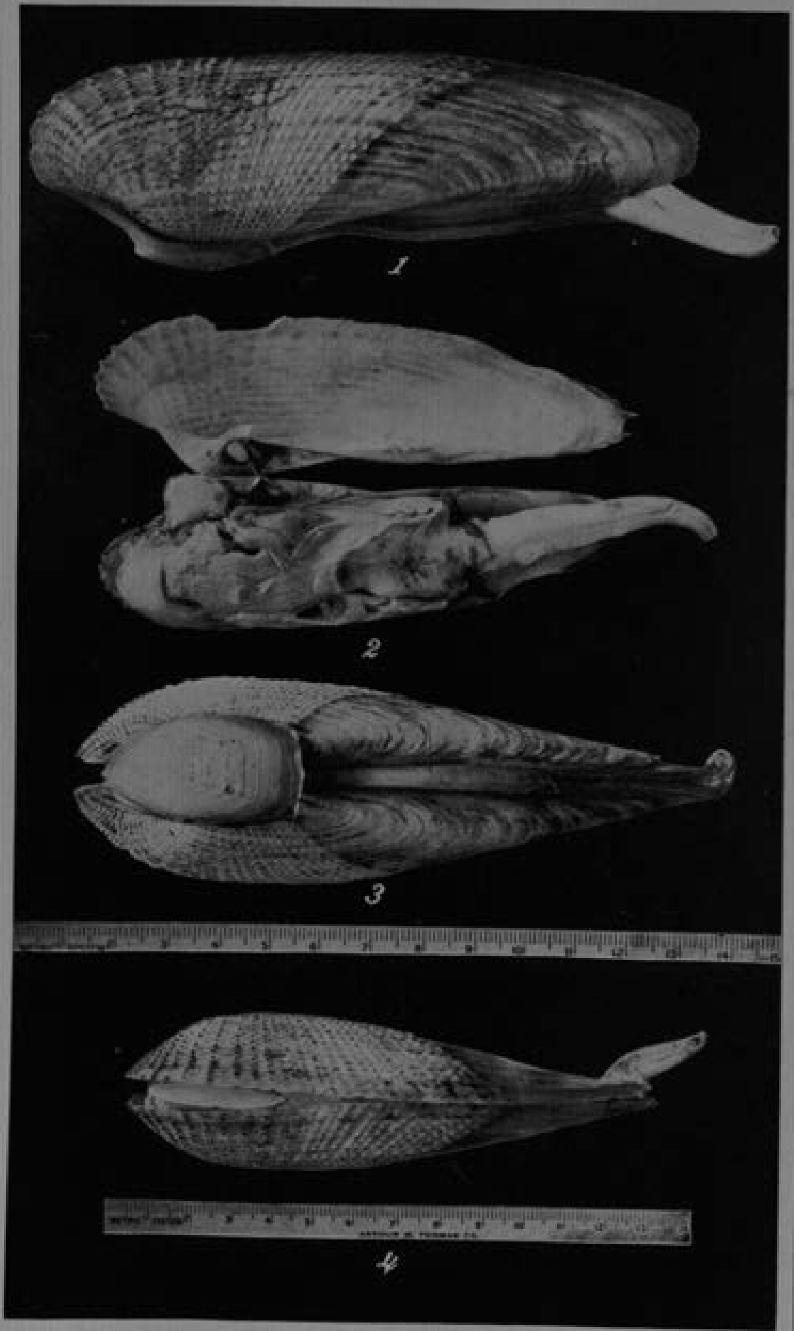
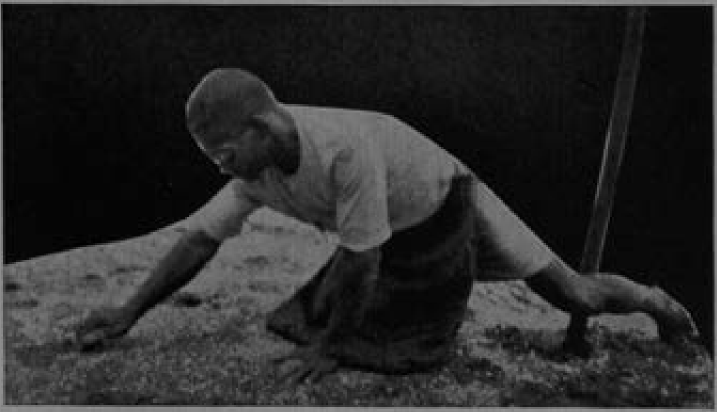


PLATE 1. PHOLAS ORIENTALIS (DIFFERENT VIEWS).



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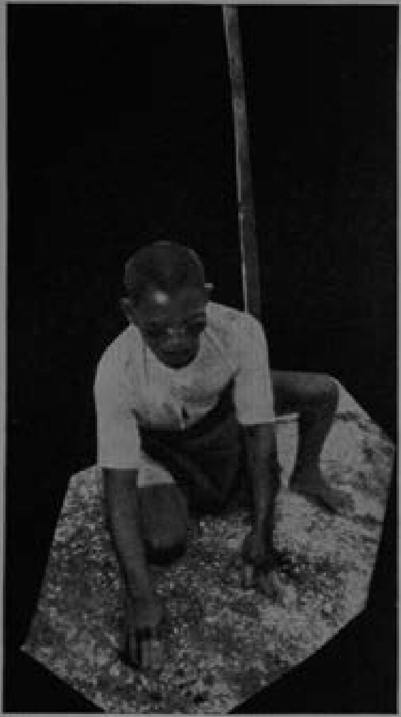

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PLATE 2. DIGGING OF PHOLAS ORIENTALIS.

TWO RARE PHILIPPINE FISHES

By CLARO MARTIN

Of the Fish and Game Administration, Bureau of Science, Manila

ONE PLATE

In June, 1936, when the writer was visiting the Zoölogy Department of Silliman University at Dumaguete, Oriental Negros Province, he was shown two specimens of fish caught off Siquijor Island. One of them is a shark sucker, the other a ground shark. Neither of them have been reported from the Philippines before. Prof. G. Magdamo, in charge of the Department, was prevailed upon to donate the specimens to the Bureau of Science, and they are here reported and described.

ECHENEIS ALBESCENS Temminck and Schlegel.

Echeneis albescens TEMMINCK and SCHLEGEL, Fauna Japon. (1842) 272, pl. 120, fig. 3; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 377; DAY, Fishes of India (1878) 258, 259, pl. 57, fig. 2.

Remora albescens BLEEKER, Ned. Tijds. Dierk. (1863) 236.

Dorsal III, 17; anal III, 19; pectoral I, 18; ventral I, 5; caudal, 18; branchiostegals, 8.

Body depressed anteriorly, subcylindrical posteriorly, slightly compressed at caudal peduncle. Head broadly depressed or flattened above, 3.7 in length as measured from anterior tip or upper lip to edge of opercle, width very slightly less than length; sucking disc broadly elliptical, with 1.7 in length, lamina 13; snout broadly rounded at tip as seen from above, 1.86 in head as measured from anterior tip of upper lip to anterior rim of eye; nostrils two, first tubular, close together; eye lateral, rounded 10 in head, 5.5 in snout; mouth obtuse, lower jaw well protruded in front; angle of mouth in line with vertical from third lamina; teeth villiform in both jaws, an outer enlarged series in lower jaw and vomer. Scales rudimentary. Dorsal inserted on fourth quarter of body, behind anal; base of anal longer than dorsal base; pectorals broad; ventrals small, inserted behind pectoral origin; caudal subtruncate, with a slight median notch.

Alcoholic specimen uniformly light brown.

Described from specimen No. 41351, 239 mm long.

ORECTOLOBUS JAPONICUS Müller and Henle. Plate 1.

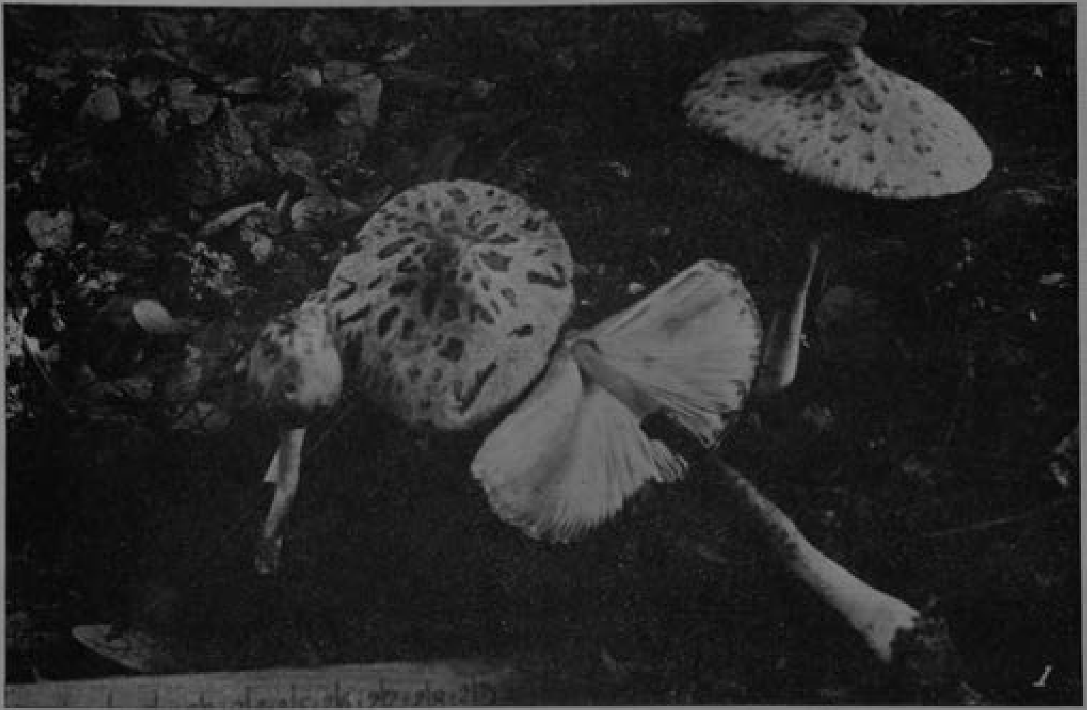
Crossorhinus barbatus MÜLLER and HENLE, Sys. Beschr. Plagiostomes (1841) 21, pl. 5; SCHLEGEL, Pisces, Fauna Japon. (1850) 301; DUMERIL, Elasmobranches, Plagiostomes et Holocéphales (1865) 338 (part); GUNTHER, Cat. Fish. Brit. Mus. 8 (1870) 414 (part).

Orectolobus barbatus JORDAN and FOWLER, Proc. U. S. Nat. Mus. 26 (1903) 606.

Orectolobus japonicus REGAN, Ann. & Mag. Nat. Hist. VII 18 (1906) 435; Proc. Zoöl. Soc. Lond. (1908) 356; GARMAN, Mem. Comp. Zoöl. Harv. 36 (1913) 50, 51.

The specimen, a male with long claspers, fits very well the description of Garman, differing from it only in the number of barbels behind the angle of the mouth. Garman's specimen has five barbels, while the present one has four; the first of these is spatulate and notched at the end, the next two are separate; the fourth is bifid near the end.

Specimen No. 41350, here reported, is 878 mm long.



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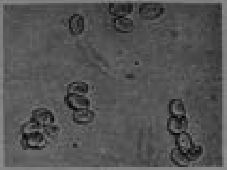

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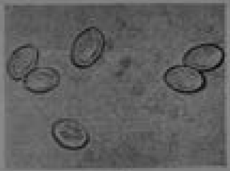

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PLATE 1.

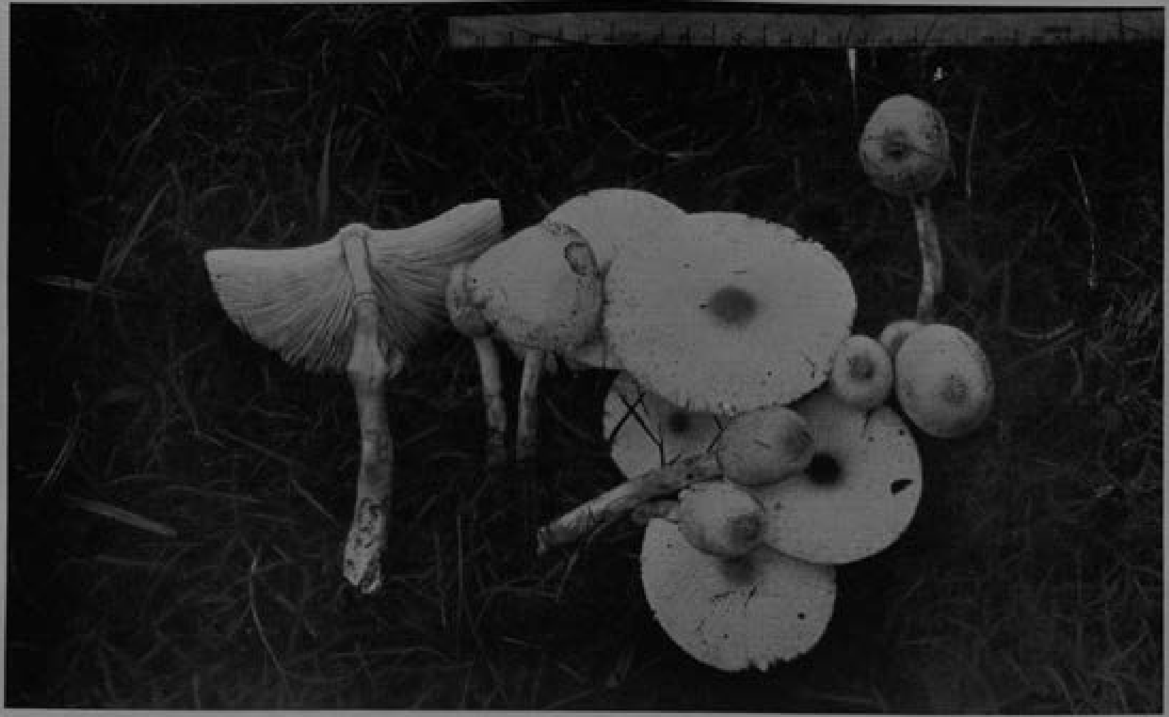


PLATE 2.

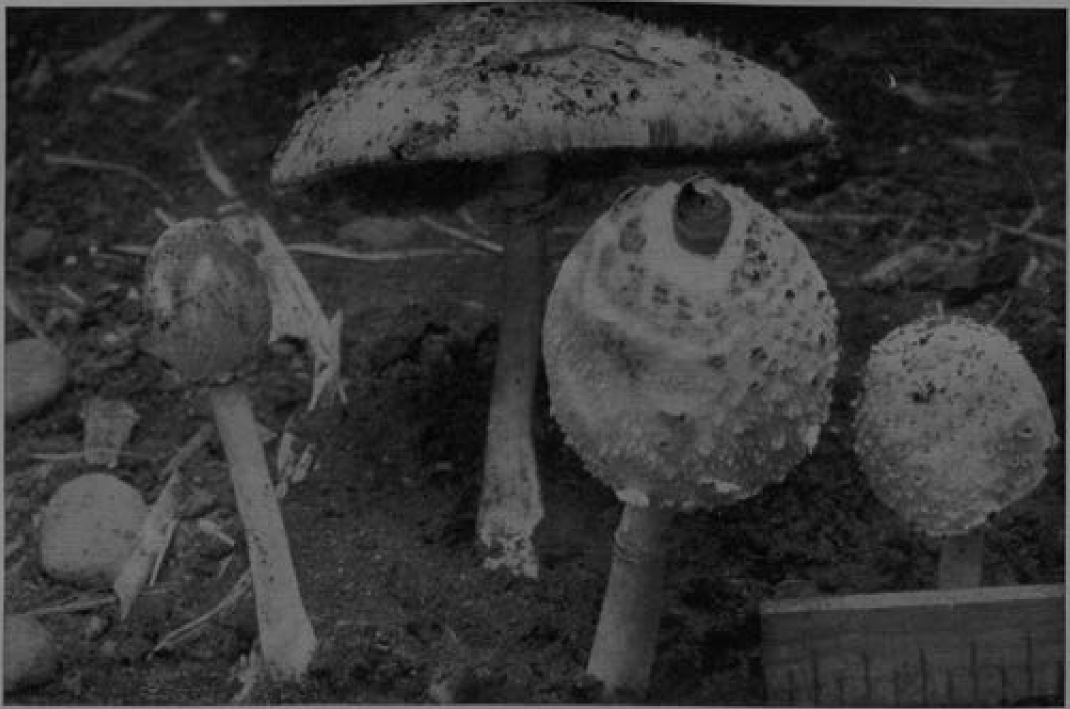
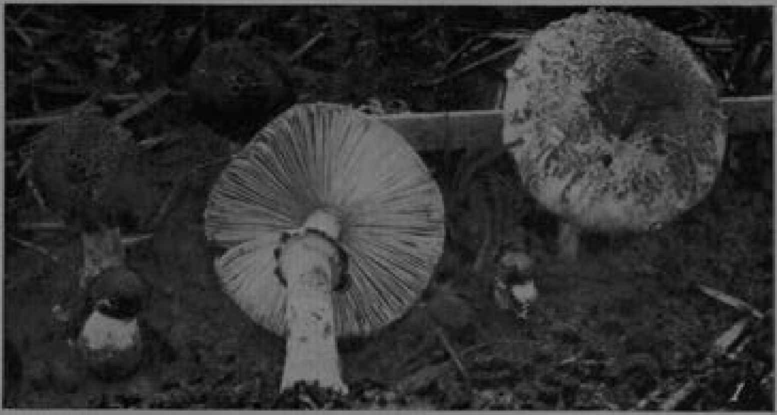
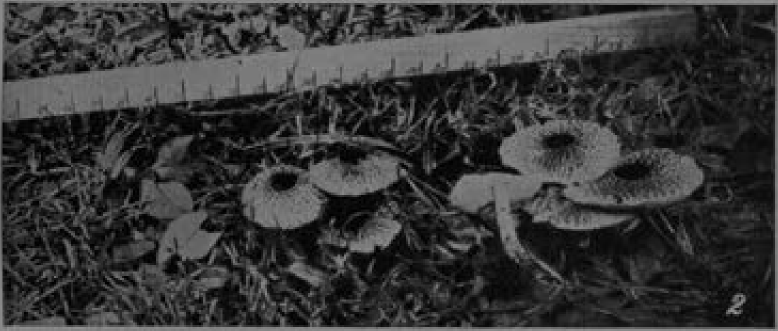


PLATE 3.





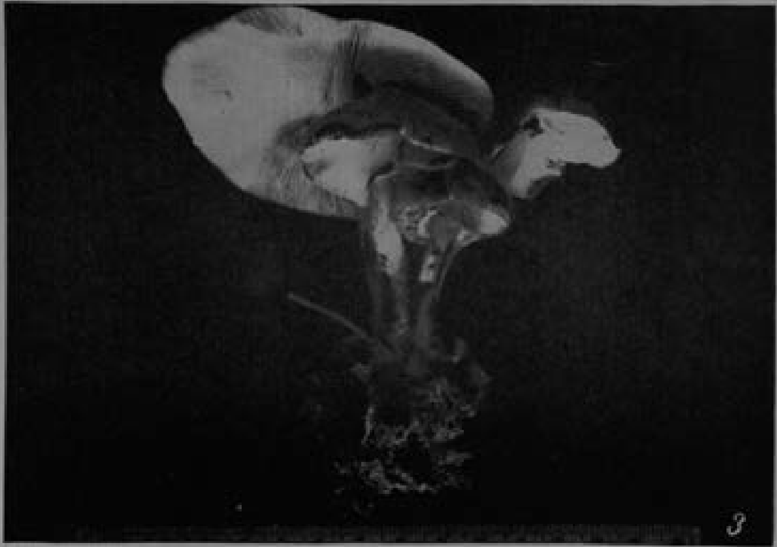
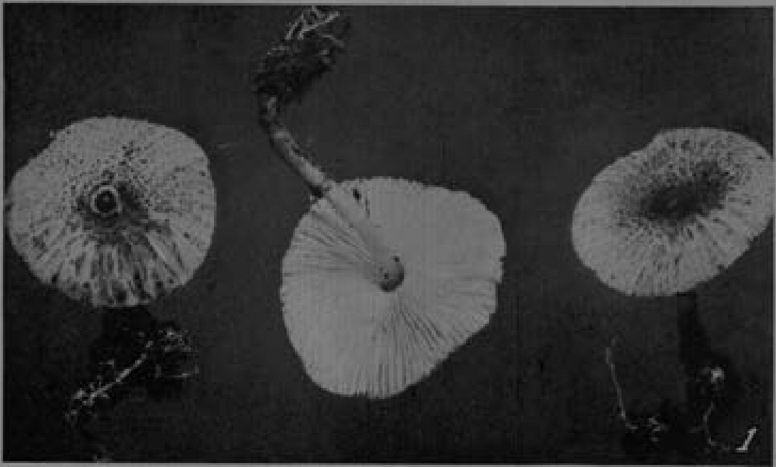


PLATE 4.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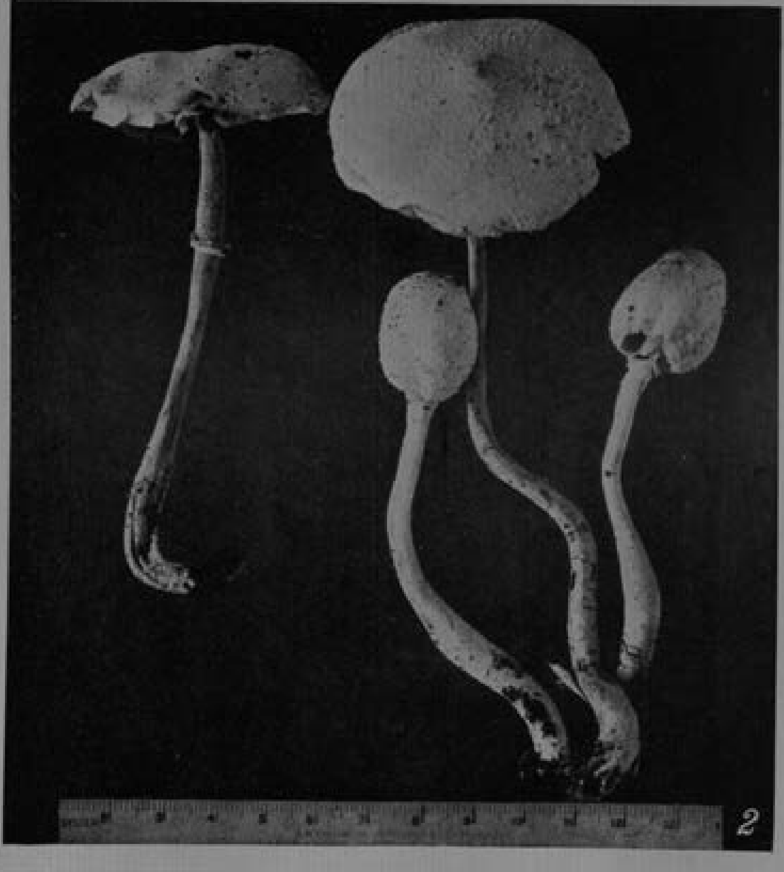
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PLATE 5.

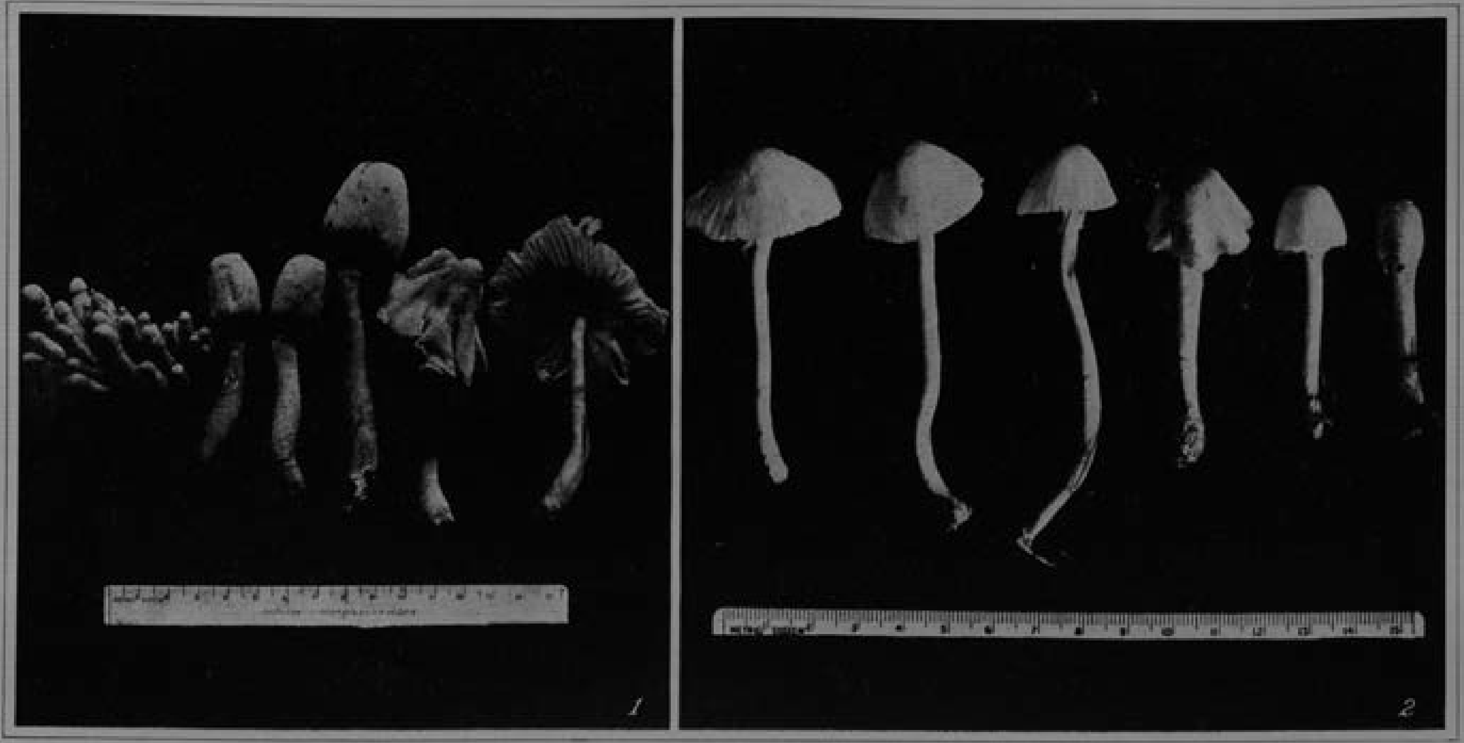

PLATE 6.

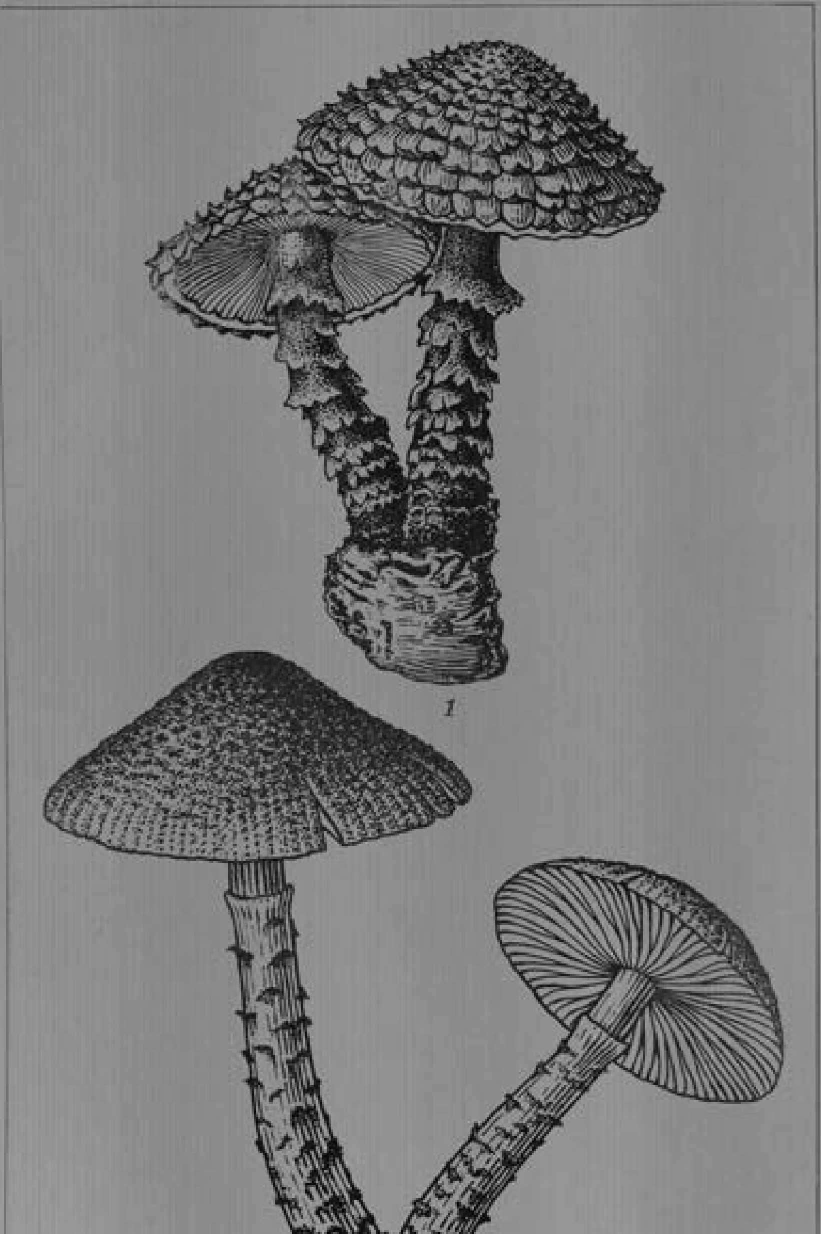

PLATE 7.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

BARBER, M. L. Basic German for science students; with vocabulary and English translations of the German passages. 3d ed. Cambridge, W. Heffer & Sons ltd., 1937. 180 pp. Price, 6s.

BUCKSTEIN, JACOB. Eat and keep fit. New York, Emerson Books, 1938. 125 pp., charts, tables. Price, $1.

Dr. Colwell's daily log for physicians. A brief, simple, accurate financial record for the physician's desk. Champaign, Ill., Colwell Publishing Co., 1938. Pages not numbered. Price, $6.

DURFEE, CHARLES H. To drink or not to drink. New York, Longmans, Green & co., 1937. 212 pp. Price, $2.

FORMAN, CHARLES. Pig breeding and feeding. The breeding and feeding of English swine in an English climate for the English market. London, Faber and Faber, ltd., 1937. 178 pp., illus. Price, 6s.

GALDSTON, IAGO. Maternal deaths—the ways to prevention. New York, The Commonwealth Fund, 1937. 115 pp. Price, $0.75.

GREGORY, EDWIN, and WALTER W. STEVENSON. Chemical analysis of metals and alloys. With a foreword by Thomas Swinden. London, Blackie & son, ltd., 1937. 375 pp. Price, $6.

HOGNESS, T. R., and WARREN C. JOHNSON. Qualitative analysis and chemical equilibrium. New York, Henry Holt & co. c1937. 417 pp., illus., tables. Price, $2.75.

MCKENNY-HUGHES, A. W. The Bed-bug; its habits and life-history and how to deal with it. 4th edition. London, British Museum (Natural History) Economic Series No. 5. 1937. 19 pp., illus. Price, 6d.

OSGOOD, EDWIN E., and CLARICE M. ASHWORTH. Atlas of hematology. With three hundred and twenty-five illustrations and frontispiece in color. San Francisco, J. W. Stacey, inc., c1937. 255 pp., illus.

PLANT, JAMES S. Personality and the cultural pattern. New York, The Commonwealth Fund, 1937. 432 pp. Price, $2.50.

SPRINKLE, LELAND W. Sprinkle's conversion formulas. Philadelphia, P. Blakiston's son & co., inc. c1938. 122 pp.

VERRILL, A. HYATT. Strange birds and their stories. Mysteries of bird life. Migrations. Nesting habits. Birds of beaches and deserts. Winged jewels. Clowns of birddom. Valuable birds. Bird law courts. Bird communists. Flightless birds. Boston, L. C. Page & co. c1938. 203 pp., plates, illus. Price, $2.50.

VERRILL, A. HYATT. Strange insects and their stories. Boston, L. C. Page & co. c1937. 205 pp., illus., plates. Price, $2.50.

VERRILL, A. HYATT. Strange reptiles and their stories. Boston, L. C. Page & co. c1937. 196 pp., illus., plates. Price, $2.50.

REVIEWS

The Control of Goiter; The Thyroid in Health and Disease. By J. Thompson Stevens. New York, A. S. Barnes and Company, 1937. 211 pp., illus. Price, $2.50.

This book is an important medical treatise on the disease generally known as goiter. Goiter is caused by pathological changes in the thyroid. It attacks a great number of people, and yet is unknown to the majority of them. Through this book the reader can obtain the necessary information about this disease.

In the early chapters of this book the author gives a detailed description of the thyroid gland and of the different endocrine glands of the body physiologically closely connected with it. In reading this book the reader gets a better idea of this important gland, its evolution, anatomical structure, and physiological activities. The essential functions of its secretion in relation to the physical development of the body and the building up of character are interestingly discussed.

This book is a clear and comprehensive study of the different types of goiter as they occur in all classes of people. It includes a careful discussion of the pathology, symptomatology, and epidemiology of this disease, and of the different factors causing its appearance in the human body. It also shows the remarkable progress made in the treatment of this disease through the advanced knowledge of this particular branch of medical science. Effective methods of treatment are discussed, such as the application of medicine, surgery, and irrigation. The author also shows the great possibility of conquering this disease, and illustrates by clinical data the results of his investigations. The information contained in this book, therefore, is of immense value, not only to the medical men but also to those who are not well acquainted with goiter.—P. J. A.

Dr. Colwell's Daily Log for Physicians; A Brief, Simple Accurate Financial Record for the Physician's Desk. Champaign, Ill., Colwell Publishing Company.

This volume is the 1938 edition of this useful record book for medical practitioners which is published annually. It consists of blank forms which are very handy for keeping record of the services and the charges for each patient, arranged by dates.

Following the daily record of each month are given forms for inoculations, business summary, income and disbursements, personal accounts, surgical record, narcotics dispensed, appointments, social security tax, and utility record. Forms are also provided for obstetrical waiting list, notifiable diseases, annual summaries, and records of deaths. The use of this record book is highly recommended to medical practitioners who want to keep record of their patients as well as of their business.

—P. S. S.

Occidental Therapeutics in the Netherlands East Indies During Three Centuries of Netherlands Settlement. (1600–1900). By D. Schoute. Batavia, Netherlands Indies Public Health Service, 1937. 214 pp.

Doctor Schoute deserves commendation for ably presenting in book form the many isolated facts of medical interest in the archives of the Netherlands East Indies and from the libraries in Holland. A great deal of the material has been drawn from the ship surgeon's journals. This book has been published on the occasion of the Inter-Governmental Conference of Far Eastern Countries on Rural Hygiene held at Bandoeng in August, 1937.

The reviewer found several interesting facts about medical problems and progress in the Netherlands East Indies which are similar to conditions in our country, such as follows:

1. Occidental therapeutics in the East Indies had its beginnings in the establishment of the United East India Company in 1602, eighty-one years after the discovery of the Philippine Islands by Magellan.

2. During the whole existence of the Company from 1600 to 1800 the medical service was entrusted to surgeons similar to our "cirujanos ministrantes" which abounded in Manila and environs during the Spanish regime and the early part of American sovereignty. The surgeons were medical men without academic attainment. They were replaced later by practitioners probably equivalent to our "practicantes."

3. The prevailing diseases in the Netherlands East Indies were similar to those occurring in our country under Spanish rule and the early part of the American occupation, such as fevers, typhoid, typhus, smallpox, malaria, dysentery, cholera, beriberi, leprosy, measles, influenza, dengue, framboesia, syphilis, pneumonia, pulmonary tuberculosis, diphtheria, tetanus, and rabies.

4. The first hospital in Java was established in 1622 at Batavia some twenty-six years after the foundation in 1596 of

San Juan de Dios Hospital, Intramuros. As it was believed that infected air was lighter than pure air the windows of the hospitals were placed high up in the walls.

5. The Javanese had, however, their School for Native Doctors in 1851, some twenty years before the establishment of the Department of Medicine in the Pontifical University of Santo Tomas, reputed to be the oldest University under the American flag. In 1898 the School for Native Doctors was transformed into the School for the Education of Native Physicians, which in turn was converted into the College of Medicine in 1927.

6. In the interests of health, and believing that Batavia lacked adequate circulation of fresh air, the walls and the gates of the city were demolished. This fact brings to one's mind the consideration whether it is advisable to have the walls and the gates of Intramuros dismantled for the sake of health or conserved for their historical significance.—R. G.

The British Plastics Yearbook, 1938; The Handbook and Guide to the Plastics Industry. London, Plastics Press Ltd. 596 pp.

In plan, style, and make-up this book is similar to its predecessors. It has the same sections as the former editions; namely, Editorial, Names and Addresses, Proprietary Names, Materials, Plant and Equipment, Manufactured Products, Associations, etc., Who's Who in the Plastic Industry, and Data. The editorial section is particularly interesting as it gives a good review of the materials of the plastic industry, plastic substitutes, cellulose acetate, ureaformaldehyde resins, and cast-phenolic resins. The last section (Data) gives tables of various kinds which are very helpful in making rapid calculations. Names, addresses, and general information useful to those interested in this line are given in the other sections. A very good book for people who wish to keep up-to-date in the plastic industry.—A. P. W.

Sterols and Related Compounds; A Series of Three Lectures Delivered at the Institute of Biochemistry, Cambridge. By E. Friedmann. Cambridge, W. Heffer & Sons Ltd., 1937. 100 pp. Price, 75d.

This book consists of a series of three lectures delivered at the Institute of Biochemistry, Cambridge, by Prof. E. Friedmann. The first lecture reviews the important researches on sterols, bile acids, heart poisons, and saponins. The second lecture is devoted to vitamin D, and the third to sex hormones and carcinogenic substances. Prof. Sir Frederick Gowland Hopkins, who wrote the foreword to this book, states:

> The extraordinary activity in the study of the sterols which recent years have seen, arising both from the inherent chemical interest of these substances and from the recognition of their immense biological importance, has produced a widely scattered literature, requiring much effort for its digestion and appraisement.
>
> Dr. Friedmann has not only brought together all the essential facts contained in that literature, but has presented them in a fashion which should be acceptable alike to organic chemists and to those whose interests are more particularly biological.
>
> He has dealt with the development of the subject on historical lines, and presented the more significant stages of that development in logical sequence. He has thus made it easy to follow the main lines of progress without neglecting the side lines which may display their own importance in the future.
>
> While dealing very thoroughly with constitutional questions and with structural relationships within the sterol group, he supplies a fully adequate account of the physiological, pathological and pharmacological properties of those members of the group which have proved to be active on such lines.

The author concludes his excellent treatise on sterols and related compounds with the following:

> The work done to elucidate these chapters of biochemistry is certainly one of the most brilliant in modern science. It carries on the great traditions of organic chemistry as a descriptive and constructive science creating permanent values. No biochemist can approach this part of biological chemistry without feelings of the highest admiration for the work done in this field and deepest gratitude to the pioneers who succeeded in deciphering these pages of Nature.

—A. P. W.

Thermodynamics; A Practical Text Covering the Fundamentals of Thermodynamics That Are Basic to the Engineering Field. By Stanton E. Winston. Chicago, American Technical Society, 1937. 176 pp., illus. Price, $1.50.

One virtue of this book is its practical, clear, and easy-to-understand treatment and presentation of the general principles of thermodynamics. This fact makes the book a good text for beginning students in engineering. Laws and processes are well explained, followed by formulas and practical problems. All sorts of practical problems are given, involving the laws of gases, thermodynamics behavior for ideal gases, heat-engine cycles, and vapors, the solutions of which are shown in such a way that they can be followed without difficulty. Engineers will also find this book a valuable guide in dealing with the various problems of heat.—M. P. R.